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MODÈLE D'ADOPTION TECHNOLOGIQUE DANS UN ENVIRONNEMENT DE GESTION DE LA CHAÎNE D'APPROVISIONNEMENT

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Cette thèse intitulée :

MODÈLE D'ADOPTION TECHNOLOGIQUE DANS UN ENVIRONNEMENT DE GESTION DE LA CHAÎNE D'APPROVISIONNEMENT

présentée par : BOECK Harold

en vue de l'obtention du diplôme de: Philosophiae Doctor

a été dûment acceptée par le jury d'examen constitué de :

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RÉSUMÉ

Cette thèse vise à mieux comprendre le processus d'adoption de systèmes d'information interorganisationnels dans un contexte de chaîne d'approvisionnement, et plus spécifiquement l'importance relative des bénéfices perçus, l'influence des pressions coercitives et le rôle des relations interentreprises.

Afin d'atteindre cet objectif général de recherche, nous nous appuyons sur quatre projets qui font partie d'un programme de recherche sur l'adoption et l'intégration des systèmes interorganisationnels. Dans le cadre de cette thèse, nous nous concentrons sur deux types de systèmes interorganisationnels, soit les applications de commerce électronique interentreprises et la technologie d'identification par fréquence-radio (RFID).

Le premier projet visait à évaluer l'utilisation du commerce électronique par les PMEs manufacturières canadiennes et leurs intentions à court terme d'adopter des applications de commerce électronique additionnelles. Un des résultats de ce projet fut de proposer la notion de trajectoires d'adoption, c'est-à-dire d'analyser comment les PME passent d'un stade élémentaire de commerce électronique (processus électroniques transactionnels) à un stade plus avancé, le stade le plus sophistiqué étant la collaboration électronique. Nous nous appuyons sur ce premier projet pour établir les niveaux d'adoption et d'intégration d'applications de commerce électronique inter-entreprises.

Le deuxième projet consistait à dégager les dynamiques organisationnelles et interorganisationnelles lors de l'adoption de pratiques d'affaires électroniques dans l'industrie des métaux primaires. Ce projet a permis d'explorer le concept de l'adoption forcée et d'observer l'influence des pressions coercitives dans les

stades d'adoption du commerce électronique.

Si les deux premiers projets ont traité des applications de commerce électronique interentreprises, les troisième et quatrième projets examinent l'impact de la technologie RFID dans deux chaînes d'approvisionnement, une dans l'industrie du détail et l'autre dans l'industrie de la distribution de l'électricité. Dans le cadre de cette thèse, nous nous sommes concentrés sur l'influence de la technologie RFID sur les relations interentreprises et les différents scénarios technologiques intégrant la technologie RFID.

Suite aux résultats présentés dans les différents articles de la thèse, il est possible de cerner certaines contributions qui se situent principalement sur deux plans, le plan conceptuel et le plan méthodologique. Sur le plan conceptuel, chacun des articles apporte un éclairage nouveau sur le processus d'adoption des systèmes interorganisationnels et contribue dans une certaine mesure à l'avancement des connaissances dans ce domaine de recherche. Ainsi, le premier article permet de mieux cerner le rôle des pressions coercitives, ce qui va à l'encontre de la littérature où les systèmes interorganisationnels sont souvent présentés comme un moyen de passer des relations transactionnelles vers des relations plus collaboratives. Le deuxième article présente la variable des relations interentreprises comme étant un déterminant important de l'adoption et de l'intégration des systèmes interorganisationnels mais cette adoption et intégration modifient à leur tour les relations interentreprises. Cette co-évolution entre relations interentreprises et infrastructure technologique mérite des efforts de recherche dans le futur. Le troisième article contribue surtout aux connaissances industrielles en démontrant que l'importance relative des bénéfices engendrés par l'utilisation de la technologie RFID pour supporter le processus de réception automatisée dans un entrepôt diffère d'entreprise en entreprise selon leur position dans la chaîne d'approvisionnement.

Les résultats de cette thèse démontrent également l'existence d'un phénomène que l'on pourrait appeler le paradoxe collaboratif. Celui-ci stipule que certaines entreprises, dans le but d'améliorer la collaboration dans leur chaîne d'approvisionnement iront déstabiliser les relations qu'elles entretiennent avec leurs partenaires d'affaires. Par exemple, lorsqu'un client influent induit des pressions coercitives auprès de ses fournisseurs pour qu'ils adoptent des systèmes interorganisationnels dans le but de resserrer les relations entre les membres d'une chaîne d'approvisionnement, une situation conflictuelle peut être créée au point de rompre les relations interentreprises. Dans le cas où la valeur de la relation est suffisamment importante, l'engagement subsistera aux pressions coercitives et entraînera une hausse de la communication et du partage de l'information et, éventuellement amènera des relations plus étroites. Dépendant du niveau de pouvoir exercé, du niveau de coopération existant et du niveau de confiance engendré, la déstabilisation de la relation peut être importante ou non. Cet effet pervers de l'adoption et de l'intégration des systèmes interorganisationnels sur les relations interentreprises n'a été pour l'instant que très peu exploré dans la littérature.

Sur le plan méthodologique, la démarche méthodologique peut être considérée comme innovante puisqu'elle intègre des méthodes qui proviennent à la fois des domaines des sciences de la gestion et des sciences appliquées. En effet, les études sur le terrain combinent des méthodes largement utilisées en gestion, telles que les études de cas par exemple tandis que les simulations en laboratoire correspondent plus au domaine des sciences appliquées et les études de temps et mouvements proviennent largement du génie industriel. Par contre, la cartographie des processus est une démarche commune aux deux domaines.

La démarche méthodologique est également innovante puisqu'elle tente de cerner l'adoption et l'intégration des processus interorganisationnels à plusieurs niveaux, au niveau du processus (par exemple, le processus de réception), au niveau de l'entreprise et au niveau de la chaîne d'approvisionnement. Notons plus spécifiquement que notre recherche a permis d'analyser plus que des relations dyadiques (clients-fournisseurs), ce qui est rarement le cas dans la littérature pour tenter d'explorer les relations interentreprises à plusieurs niveaux de la chaîne d'approvisionnement. Le troisième article analyse les relations interentreprises à quatre niveaux de la chaine d'approvisionnement. Enfin, le fait d'obtenir de l'évidence empirique dans trois industries différentes, soit les métaux primaires, la vente au détail et le secteur de l'énergie, garantit une certaine validité externe. Mentionnons que le premier article traite d'une industrie rarement étudiée, celle des métaux primaires.

Finalement, la thèse présente quelques recommandations et conclut avec des avenues de recherche futures.

ABSTRACT

This thesis aims at understanding the adoption process of Interorganizational Systems (IOS) within supply chains and more specifically, to assess the relative importance of the perceived benefits, the influence of coercive pressures and the role of inter-firm relationships.

Four separate projects with a specific focus on two main types of IOS, namely business-to-business e-commerce applications and Radio Frequency Identification (RFID) technology have been undertaken to reach this research objective.

The first project examines the e-commerce adoption processes by Canadian Small and Medium Enterprises (SMEs) in the manufacturing sector and their intention to adopt additional e-commerce applications in the near future. One of the results of this project is to propose the notion of adoption trajectories to analyze how SMEs evolve from an elementary stage of e-commerce adoption to more advanced stages, namely Electronic information search & content creation, Electronic transactions, Complex electronic transactions and Electronic collaboration. The first project allows to establish the adoption and integration stages of B2B applications.

The second project sheds some light on the organizational and interorganizational dynamics present when adopting B2B applications in the specific context of the primary metals industry. This project allows to explore the concept of forced adoption and to observe the influence of coercive pressures in e-commerce adoption stages.

The first two projects focused on B2B applications whereas the third and fourth projects examined the impact of RFID technology in two separate supply chains. The third project takes place in the retail industry while the fourth one is conducted in the energy sector. In this thesis, we opted to focus on inter-firm relationships, the different technological scenarios that integrate this technology and perceived benefits derived from RFID technology.

Based on the results presented in the different articles of the thesis, it is possible to ascertain certain contributions that fall mostly within two realms, conceptual contributions and methodological contributions. From the conceptual perspective, each article examines the IOS adoption process and contributes in a certain measure to the advancement of knowledge in this research field. The first article identifies the role of coercive pressures which differs from the academic mainstream literature where IOS are often presented as a means for companies to evolve from transactional to more collaborative relationships. The second article presents supplier-buyer relationships and more generally inter-firm relationships as both crucial antecedents that shape RFID infrastructure and the consequence of RFID implementation. The third article contributes mostly to industrial knowledge by demonstrating that the relative importance of the benefits achieved by using RFID technology to support automated receiving in a warehouse differs from business to business depending on its position in the supply chain.

The results of this thesis also demonstrate the existence of a phenomenon that we could call the "collaborative paradox". Certain companies, in order to improve the collaboration within their supply chain will destabilize the established relationships with their business partners. For example, when an influential client uses coercive pressures on its suppliers so they adopt IOS in order to improve collaboration, a conflicting situation can be created to the point where business relationships are ruptured. In a situation where the value of the relationship is sufficiently important, commitment will endure and bring about an increase in communication and information sharing, which will eventually lead to tighter relationships. The level of power, the level of existing cooperation and the level of the existing trust will moderate the destabilization process. This perverse effect of the adoption and integration of IOS on buyer-seller relationships has for now rarely been the focus of study.

From the methodological perspective, the approach retained here can be considered innovative as it integrates methods that stem from the fields of administrative and applied sciences. For example, case studies are largely used in management whereas laboratory simulations fall mostly in the realm of applied sciences and time in movement studies originate from industrial engineering. Business process mapping however, is an approach that is common to all fields.

The methodological approach is also innovative because it attempts to assess the adoption and integration of IOS at many levels: the process level (for example, the reception process), the level of the firm and that the level of the supply chain. This highlights the fact that our research has analyzed more than dyadic buyer seller relationships which often remains at this level in the academic literature. The third article analyzes inter-firm relationships at four levels of the supply chain. Finally, by obtaining empirical evidence from three different industries namely, the primary metal industry, the retail industry and energy industry, a certain level of external validity is reached. Additionally, the first article focuses on the primary metals industry which is rarely studied.

The thesis also presents some recommendations and concludes with future research avenues.

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CHAPITRE 1. INTRODUCTION

La mondialisation des marchés et la nécessité de se spécialiser dans des activités à valeur ajoutée contribuent à l'émergence de chaînes d'approvisionnement dans lesquelles plusieurs entreprises collaborent ensemble afin de livrer un produit final aux consommateurs. Or, une collaboration appropriée ne peut être obtenue qu'avec une communication accrue et un partage rapide et efficace de l'information. Les systèmes interorganisationnels tels les systèmes d'approvisionnement électronique, les systèmes d'échanges de documents informatisés (EDI), les places d'affaires électroniques et la technologie d'identification par fréquence-radio (RFID) viennent justement soutenir les processus interentreprises et, par ce fait, permettent une intégration accrue des chaînes d'approvisionnement. Une telle intégration procure aux entreprises membres d'une chaîne d'approvisionnement des avantages concurrentiels tels qu'une réponse plus rapide aux besoins de la clientèle, des délais d'intervention réduits, une gestion plus étroite des stocks, une rationalisation plus poussée des processus de livraison et d'expédition et un suivi plus efficace sur toute la chaîne d'approvisionnement.

Afin d'obtenir ces avantages, certaines entreprises, souvent des clients ou donneurs d'ordres importants, seront tentées d'influencer ou même d'imposer leurs choix technologiques auprès de leurs partenaires d'affaires.

1.1. Le paradoxe collaboratif

Dans le cas de l'adoption d'une technologie qui supporte la gestion de la chaîne d'approvisionnement, nous nous retrouvons face à un paradoxe. Afin d'augmenter la collaboration, une entreprise peut, dans certains cas, avoir recours à des mesures coercitives. Par exemple, il semblerait a priori que l'initiative RFID de Wal-Mart, qui a comme objectif d'améliorer la collaboration de sa chaîne d'approvisionnement, aurait eu l'effet pervers de déstabiliser les relations interentreprises (Fogarty, 2004; Romanow, 2004; Schwartz, 2004). Pire encore, une étude récente indique que certains fournisseurs implanteront la technologie RFID afin de satisfaire les besoins de leurs clients et ce, à leur propres dépens (Hingley et al. 2007). Ces observations semblent être contradictoires avec une approche collaborative et nous rappelle que peu est encore connu en matière d'adoption de technologies supportant la gestion de la chaîne d'approvisionnement.

1.2. Problématique générale

Notre sujet de recherche vise justement à mieux comprendre le processus d'adoption de systèmes d'information interorganisationnels dans un contexte de chaîne d'approvisionnement, et plus spécifiquement l'importance relative des bénéfices perçus, l'influence des pressions coercitives et le rôle des relations interentreprises.

1.3. But de l'étude

Le but de l'étude est d'éclaircir le paradoxe collaboratif que nous venons de présenter. Puisque les systèmes interorganisationnels et le paradigme managérial de la gestion de la chaîne d'approvisionnement sont des phénomènes relativement récents, peu d'études traitent conjointement de ces phénomènes dans un contexte d'adoption induite voire même forcée. Notre recherche sera donc de type exploratoire et explicatif et visera à nous aider à mieux comprendre le phénomène de manière générale. Deuxièmement, l'étude tentera de contribuer aux théories de l'adoption dans le contexte d'une chaîne d'approvisionnement. Plus spécifiquement, elle visera à mieux comprendre les liens qui existent entre les systèmes interorganisationnels et les relations interentreprises.

1.4. Pertinence et originalité du sujet

Grâce aux éléments énoncés précédemment, il est possible de dire que le sujet de recherche est d'actualité, le demeurera pour les années à venir et est d'une importance capitale pour l'entreprise voulant se doter d'une stratégie de gestion de la chaîne d'approvisionnement. De plus, il est essentiel pour comprendre l'adoption des systèmes interorganisationnels et en particulier, l'une de ses plus récentes formes, soit la technologie RFID dans un contexte de chaîne d'approvisionnement.

De plus, cette thèse contribue aux théories portant sur les relations interentreprises et celle de la diffusion des innovations. Elle répond également aux préoccupations de plusieurs chercheurs qui indiquent que plus de recherche est nécessaire afin de démystifier le lien qui existe entre l'adoption technologique et la nature des relations interentreprises (Angeles, 2006; Carr et Smeltzer, 2002; Gemünden et al. 2003; Leek et al. 2002; Rebolledo et al. 2005).

Cette thèse est organisée de la manière suivante. Le chapitre 2 présente une revue de littérature qui nous permettra de mieux comprendre le phénomène étudié en se basant sur des études effectuées précédemment. Le chapitre 3 présente la démarche qui fut effectuée afin de répondre à la problématique générale et aux problématiques spécifiques soulevées. Les chapitres 4, 5 et 6 présentent trois articles qui furent rédigés afin de présenter les résultats de la recherche. Les chapitres 7 et 8 viennent présenter une discussion des résultats et conclure cette thèse en nous amenant à considérer des pistes de recherches futures. Finalement, deux annexes présentent des articles additionnels qui complètent la recherche entreprise dans le cadre de cette thèse.

CHAPITRE 2. REVUE DE LITTÉRATURE

Cette thèse s'inscrit dans un courant académique plus large qui englobe une évolution importante dans la littérature.

Nul ne peut nier l'importance stratégique des facteurs organisationnels tels que la disponibilité des ressources, la présence de compétences clés ou le soutien de la haute direction lors de l'adoption d'innovations technologiques. Cependant, plusieurs affirmeront qu'au contraire, ce sont les individus qui jouent un rôle important dans l'adoption, l'appropriation et la diffusion des innovations (Schultze & Orlikowski, 2004). De plus, les individus représentent la clef d'une collaboration efficace entre entreprises et ce facteur ne devrait pas être ignoré lors d'un projet d'adoption d'innovations technologiques (Fawcett et al. 2008). Les relations sont d'une importance capitale dans un contexte d'affaires et peuvent même affecter la capacité d'innover (Soosay et al. 2008). L'aspect relationnel a donc pris de l'ampleur dans la littérature au cours des dernières années. Plusieurs auteurs ont affirmé que les interactions entre entreprises seraient moins transactionnelles pour devenir plus collaboratives. Or, cette affirmation semblerait exiger plus d'efforts de recherche car il existe peu d'évidences empiriques à ce sujet (Brodie et al. 2008).

C'est donc dans cette avenue de recherche que notre ouvrage s'inscrit. Nous tenterons de démontrer le fait que certaines technologies, dans le but de créer de créer des relations plus solides, doivent initialement les bouleverser. Ce paradoxe nécessite de trouver le juste équilibre dans une démarche très complexe. Plus précisément, nous examinerons le rôle des relations interentreprises lors de l'adoption des systèmes interorganisationnels dans le contexte spécifique de chaînes d'approvisionnement.

2.1 La gestion de la chaîne d'approvisionnement

2.1.1. L'origine et la définition de la gestion de la chaîne d'approvisionnement

Une chaîne d'approvisionnement fait référence au regroupement d'entreprises qui travaillent ensemble dans le but de créer, fabriquer et/ou livrer un produit à un consommateur. La gestion de cette chaîne d'entreprises, qui est considéré comme une entité en soi, est connu sous le terme de « gestion de la chaîne d'approvisionnement ». La gestion de la chaîne d'approvisionnement parfois aussi appelée la gestion de la chaîne logistique mais mieux connue sous son terme anglais « Supply Chain Management » est un phénomène relativement récent (Mentzer et al. 2001; Mills et al. 2004) qui a pris une ampleur importante dans la littérature scientifique lors de la dernière décennie (Mentzer et al. 2001).

Avant de procéder plus loin, il est impératif de définir le concept de la gestion de la chaîne d'approvisionnement qui sera central dans cet ouvrage. Il est d'autant plus important d'effectuer cette étape que ce concept est souvent utilisé de différentes manières dans la littérature scientifique. Il s'est d'ailleurs développé une riche littérature autour de ce phénomène qui transcende plusieurs écoles de pensée. Suite à une revue de littérature de plus de 400 articles sur le sujet de la chaîne d'approvisionnement, Chen et Paulraj ont déterminé que les origines de ce terme proviennent de plusieurs domaines scientifiques, soit du domaine de la gestion de la qualité, la gestion des matériels et de la logistique intégrée, et le marketing industriel (Chen et Paulraj, 2004). Historiquement, le terme gestion de la chaîne d'approvisionnement était utilisé dans un contexte de logistique mais a depuis évolué pour désigner l'intégration des processus d'affaires de toutes les entreprises conjointement responsables de livrer un produit ou un service à un client final (Mills et al. 2004; Chen et Paulraj, 2004). Dans cet ouvrage, nous utiliserons la définition probablement la plus reconnue de la gestion de la chaîne d'approvisionnement tel que proposée par Mentzer et al. (2001) et qui reprend très bien ses principaux éléments:

> *"Supply chain management is defined as the systemic, strategic coordination of the traditional business functions and the tactics across these business functions within a particular company and across businesses within the supply chain, for the purpose of improving the long-term performance of the individual companies and the supply chain as a whole." (p.18)*

Une traduction libre de cette définition en anglais nous fournit le texte suivant : La gestion de la chaîne d'approvisionnement est définie comme étant la coordination systémique et stratégique des fonctions d'affaires traditionnelles ainsi que les tactiques qui chevauchent les fonctions d'affaires dans une entreprise spécifique et parmi les autres entreprises de la chaîne d'approvisionnement dans le but d'améliorer les performances à long terme des entreprises individuelles et de l'ensemble de la chaîne d'approvisionnement.

De plus, cette définition va de pair avec celle qui est utilisée dans l'industrie par le regroupement d'entreprises « Supply-Chain Council » qui se préoccupe du développement de pratiques, de définitions et de mesures standardisées afin de faciliter la collaboration entre les entreprises (Supply-Chain Council, 2008).

2.1.2. La gestion de la chaîne d'approvisionnement comme approche stratégique

Ce paradigme organisationnel va de pair avec un nouveau paradigme managérial. Historiquement, une entreprise tentait de devenir plus forte que ses compétiteurs avec la prémisse qu'elle était par elle-même un organisme autosuffisant. Puis, s'est développée l'idée qu'aucune entreprise ne pouvait être représentée comme étant un îlot séparé du marché (Hakansson et Snehota,

1989) car elle est plutôt la résultante des interactions de l'entreprise avec ce marché (Ford, 1998) dans (Durrieu et al. 2001). Cesser de considérer l'entreprise comme un organisme autosuffisant était le premier pas vers une gestion collaborative qui reconnaissait que les entreprises sont plus fortes en équipe.

Cette gestion collaborative nécessite, comme prérequis, que toutes les entreprises le long de la chaîne d'approvisionnement doivent être nécessairement orientées vers cette idéologie managériale (Mentzer et al. 2001). Ainsi, plusieurs affirment qu'une transformation s'effectue auprès des entreprises qui passent maintenant d'une approche traditionnellement plus compétitive vers une approche plus collaborative (Hoyt et Huq, 2000; Spekman et Carraway, 2006).

Stratégiquement, la compétition dans un tel environnement d'affaires ne s'effectue plus entre entreprises mais plutôt au niveau des chaînes d'approvisionnement (Gomes-Casseres, 1994; Angeles et Nath, 2000; Doz et al. 2000; Lefebvre et al. 2008), c'est-à-dire d'un regroupement d'entreprises contre un autre. Les entreprises tendront donc à développer une collaboration accrue afin d'obtenir un avantage collaboratif (Chen et Paulraj, 2004; Dyer, 2000) plutôt qu'un avantage compétitif tel que préconisé depuis les années 1980 (Porter, 1985). À titre d'exemple, l'entreprise américaine Whirpool a su se réinventer en améliorant sa chaîne d'approvisionnement et ainsi redevenir compétitive sur le marché (Slone, 2004). Considérons également l'exemple de la chaîne de magasins espagnols Zara. Cette entreprise qui œuvre dans l'industrie du vêtement avait, en 2004, 650 magasins à son actif. Elle a misé sur une chaîne d'approvisionnement efficace et rapide (Ferdows et al. 2004), ce qui a grandement contribué à son succès.

Avec cet important changement de gestion, la manière d'analyser les dynamiques industrielles s'est significativement transformée. Ainsi, de nouveaux outils et de nouvelles théories ont dû être développés dans le but d'analyser les chaînes d'entreprises. Par exemple, certains auteurs nous démontrent que lorsque nous considérons la chaîne d'approvisionnement dans son ensemble, nous sommes en mesure d'obtenir une image plus complète d'une situation d'affaires. À cet effet, une analyse de la gestion de l'inventaire dans le contexte d'une chaîne d'approvisionnement nous démontre qu'il est plus rentable pour les joueurs de la chaîne de conserver l'inventaire chez les premières entreprises de la chaîne (Lambert et Pohlen, 2001). De cette manière, cette chaîne et toutes les entreprises qui la composent se trouvent donc plus compétitives face aux chaînes adverses.

Cependant, c'est fort probablement le concept de l'effet du coup de fouet qui démontre l'importance de gérer l'inventaire dans l'ensemble de la chaîne d'approvisionnement. Ce concept connu sous le terme anglais « bull whip effect » a été initialement proposé en 1997 (Lee et al. 1997) et a été repris par la suite par plusieurs auteurs dont (Chen et al. 2000; Zhenxin Yu et al. 2001; Kimbrough et al. 2001; Frohlich et Westbrook, 2002; Dejonckheere et al. 2003). L'effet coup de fouet dont l'importance théorique ne peut être déniée (Mills et al. 2004), se produit lorsque de légères fluctuations de la demande en aval déclenchent des fluctuations beaucoup plus importantes au fur et à mesure que la demande se propage vers l'amont de la chaîne d'approvisionnement. Une importante cause de l'effet coup de fouet provient d'un manque de partage de l'information entre les intervenants. Afin de réduire l'effet coup fouet, la chaîne d'approvisionnement doit donc être en mesure de partager les informations liées à la demande plus efficacement. En effet, une simulation mathématique a démontré que l'élimination des inexactitudes dans les niveaux d'inventaire réduisait les coûts de la chaîne d'approvisionnement et les ruptures d'inventaire

(Fleisch et Tellkamp, 2005). Cependant, la réalité d'affaires est beaucoup plus complexe qu'une simulation mathématique. Et, quoique plusieurs entreprises désiraient obtenir un important niveau d'intégration de leur chaîne d'approvisionnement, il est parfois difficile de l'obtenir (van Donk et al. 2008).

2.2. Le rôle des systèmes interorganisationnels pour soutenir la gestion de la chaîne d'approvisionnement

Les technologies de l'information sont d'une importance capitale dans la chaîne d'approvisionnement puisque le partage de l'information et la coordination y sont essentiels. Ainsi, certains auteurs iront jusqu'à proposer que ces technologies soient une condition sine qua non à l'opérationnalisation efficace de la gestion de la chaîne d'approvisionnement (Lejeune et Yakova, 2005; Gunasekaran et Ngai, 2004; Byrd et Davidson, 2003). D'autres, plus modérés, affirment simplement que les logiciels interentreprises ont des effets positifs sur la chaîne d'approvisionnement (Liu et al. 2005) ou qu'une utilisation inadéquate de ces logiciels peut mener à certaines inefficacités comme une augmentation de l'inventaire (Disney et al. 2004). En général, il a été démontré que l'utilisation de technologies collaboratives axées sur le partage de l'information contribue à une performance organisationnelle plus élevée (Lefebvre et al. 2008; Merono-Cerdan et al. 2008). Il en va de même pour d'autres technologies collaboratives tel l'approvisionnement électronique qui permet de réduire le temps de réaction de l'entreprise et aussi de l'aligner plus efficacement aux besoins du marché (Ordanini et Rubera, 2008).

Le terme systèmes d'information interorganisationnels provient du terme anglais « Interorganizational Information System (IOS) » et est souvent défini comme étant :

"an automated information system shared by two or more companies. An

> *IOS is built around information technology, that is, around computer and communication technology, that facilitates the creation, storage, transformation and transmission of information. An IOS differs from an internal distributed information system by allowing information to be sent across organizational boundaries" (Johnston et Vitale, 1988).*

Un système d'information interorganisationnel est donc un système d'information automatique et partagé par au moins deux entreprises. Un système d'information interorganisationnel se base sur les technologies de l'information, c'est-à-dire, à partir des ordinateurs et des technologies de communication qui facilitent la création, l'archivage, la transformation et la transmission de l'information. Un système d'information interorganisationnel diffère des systèmes d'information distribuée à l'intérieur de l'entreprise puisqu'il transcende les frontières organisationnelles. Afin de simplifier la lecture, nous abrégerons l'expression systèmes d'information interorganisationnels par systèmes interorganisationnels dans le texte subséquent.

Un système interorganisationnel peut prendre plusieurs formes. Au tout début, les technologies permettant l'échange de documents informatisés (EDI) ont été adoptées dès les années 1960 (Clarke, 2001) bien avant l'arrivée du Web (Ramaseshan, 1997). Elles consistent en un échange entre deux partenaires d'affaires de documents informatisés possédant une structure standardisée (Power et Sohal, 2002). Ces documents peuvent prendre la forme de bons de commande, de factures, de bons de connaissement, etc. Avant l'utilisation de l'EDI, les communications interentreprises s'effectuaient surtout par courrier, téléphone et télécopieur. L'EDI avait comme avantage de réduire les coûts de communication tout en augmentant son exactitude. Le transfert des documents EDI s'effectuait traditionnellement par le biais d'un réseau privé à valeur ajoutée mais, aujourd'hui, ces échanges transactionnels tendent à utiliser l'infrastructure d'Internet car elle est moins coûteuse. L'EDI répond à la définition d'un système interorganisationnel, car cette technologie est partagée par au moins deux entreprises, se base sur les technologies de l'information et transcende les frontières organisationnelles.

Une évolution tout à fait naturelle de l'EDI sur réseau privé s'est effectuée vers l'infrastructure plus ouverte qu'est Internet. En prenant la forme de sites Web et d'extranets, l'arrivée du Web au début des années 1990 a permis de démocratiser les systèmes interorganisationnels en offrant une solution moins complexe, moins structurée et moins chère.

Puis, un peu plus tard, durant la fin des années 1990, l'évolution des systèmes interorganisationnels a permis aux systèmes d'approvisionnement électronique d'apparaître. Ceux-ci permettent aux entreprises de créer des liens électroniques avec plusieurs fournisseurs (Puschmann et Alt, 2005). Ainsi, ces fournisseurs peuvent, en accédant à des logiciels spécialisés par Internet, mettre à jour l'offre de leurs produits pour leurs clients qui possèdent ces logiciels. L'objectif principal de ces systèmes était de réduire les coûts d'opération et de recherche lors des activités d'approvisionnement (Dai et Kauffman, 2001). Cependant, un inconvénient majeur de ce système était qu'il requiert de la part des fournisseurs de mettre à jour tous les systèmes d'approvisionnement électronique de chacun de leurs clients. Cet inconvénient peut représenter un processus très coûteux et fastidieux si le fournisseur dessert plusieurs clients qui utilisent différents systèmes.

Afin de remédier à cet inconvénient, les places d'affaires électroniques sont apparues vers la fin des années 1990 (Puschmann et Alt, 2005). Ces places d'affaires électroniques se basent sur le fonctionnement des marchés plus traditionnels. Ainsi, plusieurs acheteurs et plusieurs fournisseurs se rejoignent à un site central qui est accessible par Internet. Sur ce site, les participants peuvent effectuer des activités de ventes et d'achats (Dai et Kauffman, 2001).

Ces systèmes répondent aussi à la définition des systèmes interorganisationnels telle que proposée par Johnston et Vitale (1988).

La figure 2.1 illustre les dynamiques transactionnelles des systèmes interorganisationnels présentés jusqu'ici. Le système EDI utilise un échange structuré entre deux entreprises par un réseau à valeur ajoutée payant. Le système Web présente un échange moins structuré que l'EDI. Le système d'approvisionnement électronique permet à plusieurs fournisseurs de contacter un client. Chaque fournisseur devra bâtir un seul lien par client. Les places d'affaires électroniques offrent un emplacement central pour échanger. Tous ces systèmes interorganisationnels facilitent l'échange d'informations entre entreprises.

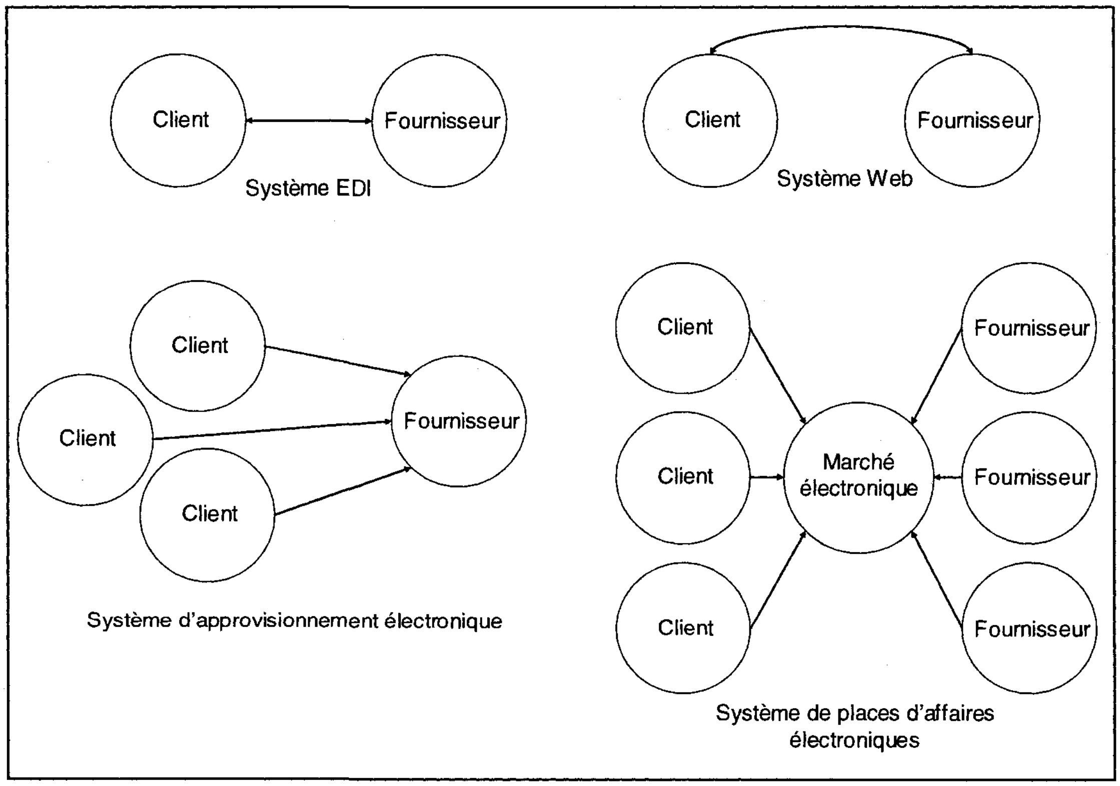

Figure 2.1 : Les dynamiques transactionnelles des systèmes interorganisationnels

Notre présentation des systèmes interorganisationnels ne pourrait être complète sans que nous présentions deux autres types de systèmes qui, quoiqu'ils répondent à la définition présentée préalablement, se consacrent beaucoup plus sur l'aspect de la capture de l'information que celui de l'échange de documents informatisés. Premièrement, les technologies de codes à barres peuvent également être considérées comme un système interorganisationnel (Vlosky et Wilson, 1994). Un code à barres est composé d'une alternance de lignes noires et blanches de différentes épaisseurs afin de représenter un numéro d'identification et peut être lu par un scanneur optique (Fiorito et al. 1998). Cette technologie est surtout utilisée pour améliorer l'exactitude et la vitesse de transmission de l'information (Manthou et Vlachopoulou, 2001).

Deuxièmement, les technologies d'identification par fréquence-radio (RFID) sont beaucoup plus récentes mais peuvent accomplir le même objectif que les codes à barres. Tel qu'illustré la figure 2.2, la technologie RFID est composée d'une puce électronique qui est connectée à une antenne. La puce électronique contient un numéro d'identification qui peut être le même que celui encodé dans le code à barres. L'antenne de la puce RFID représente l'innovation radicale du système. Cette antenne permet une communication avec la puce électronique sans contact physique ou visuel (Kärkkäinen et Holmström, 2002) avec celle-ci et à une distance pouvant parfois atteindre une distance de plusieurs centaines de mètres. Les utilisateurs précoces de cette technologie, les chefs de file industriels ainsi que les chercheurs s'entendent pour dire que la technologie RFID facilite la collaboration entre les entreprises (Cantwell, 2006; Lefebvre et al. 2006; Lekakos, 2007; Roberti, 2006) et qu'elles contribuent par ce fait à supporter la gestion de la chaîne d'approvisionnement (Attaran, 2007; Pramatari, 2007).

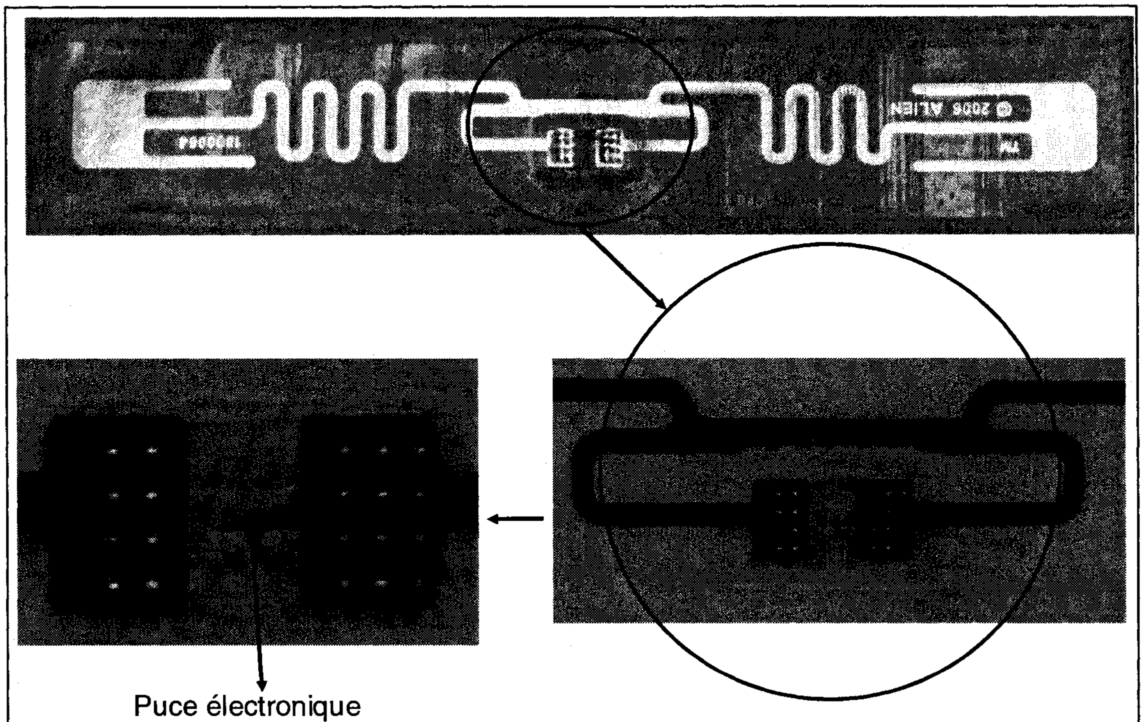

Figure 2.2 : Un marqueur RFID passif et sa puce électronique

Dans les deux cas, les technologies de codes à barres et les technologies d'identification par fréquence-radio représentent des systèmes interorganisationnels car, lorsque le manufacturier encode un code à barres ou une puce RFID et qu'une autre entreprise de la chaîne d'approvisionnement lit l'information qu'ils contiennent, nous nous retrouvons avec un système qui répond à la définition présentée préalablement des systèmes interorganisationnels. Dans cette situation, la technologie RFID est alors combinée à un réseau de lecteurs partagés entre les entreprises afin de devenir un système organisationnel (Riggins et Slaughter, 2006) et présente ainsi des opportunités pour transformer la chaîne d'approvisionnement (Curtin et al, 2007).

Un avantage collaboratif ne peut être réalisé que si les entreprises d'une même chaîne d'approvisionnement s'entendent sur les mêmes choix au niveau des systèmes interorganisationnels. Si une entreprise (l'entreprise instigatrice) désire optimiser sa chaîne d'approvisionnement, elle devra donc réussir à convaincre ses partenaires (entreprises incitées) d'utiliser le système qu'elle a privilégié. Ceci implique que les partenaires d'affaires peuvent soit être d'accord avec l'initiative et se porter volontaire ou, ne pas être en accord avec l'initiative. Si un partenaire n'est pas en accord avec l'initiative, il peut tout de même décider de s'aligner volontairement avec l'entreprise investigatrice. Nous nous retrouvons donc avec trois possibilités : refus d'adopter, adoption volontaire ou adoption forcée, comme l'indique la figure 2.3.

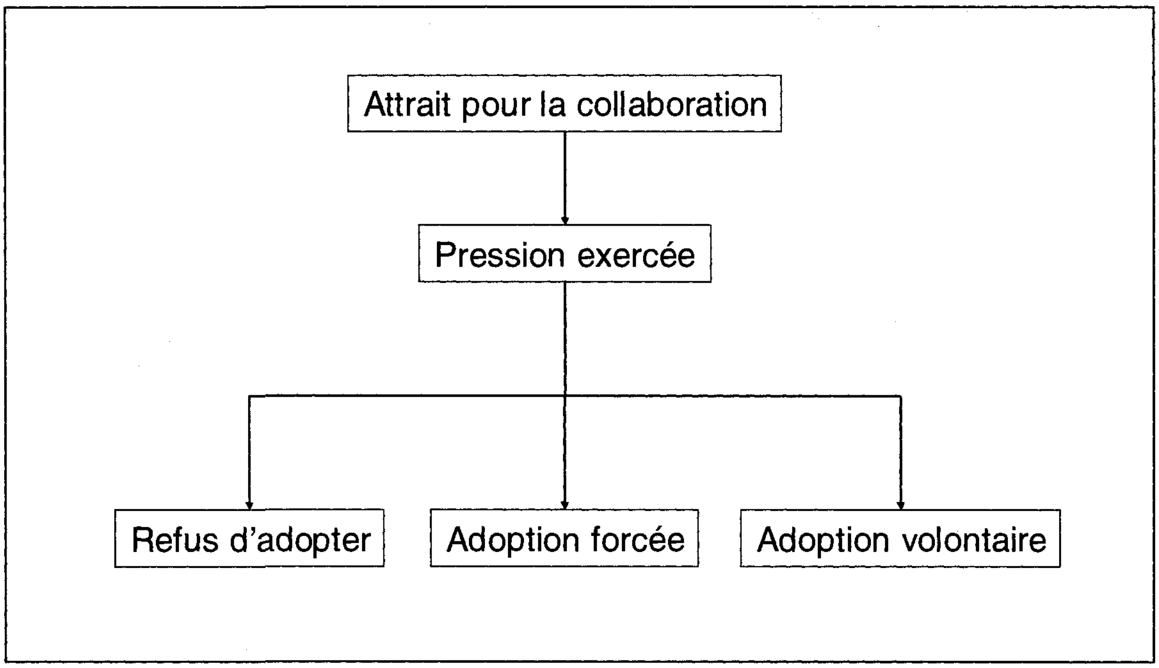

Figure 2.3 : Réactions possibles aux pressions exercées pour l'adoption d'un système interorganisationnel

2.3. La collaboration engendrée par des pressions exercées

Malgré que les principes de la gestion de la chaîne d'approvisionnement soient louables, c'est-à-dire qu'ils préconisent un esprit de collaboration afin d'aligner les entreprises partenaires vers un objectif et des efforts communs, dans les pratiques courantes, certaines entreprises tardent encore à adopter des technologies qui supportent le concept de la gestion de la chaîne d'approvisionnement (Quayle, 2003). Plutôt que la collaboration entre les entreprises, un esprit compétitif règne encore entre plusieurs acheteurs et vendeurs industriels (Spekman et al. 1998). Cela pourrait expliquer que des entreprises fortement influentes exercent leur pouvoir afin de contrôler en partie les agissements de leurs partenaires (Quayle, 2003). Cette explication est également avancée dans le milieu académique. Une revue de littérature qui portait sur le thème des réseaux interorganisationnels et provenant de 158 articles démontre que le principal paradigme de recherche tend à percevoir les réseaux d'entreprises comme une réaction face aux entreprises qui tentent d'atteindre le succès par le truchement du contrôle et du pouvoir (Oliver, 1998).

Quoiqu'il en soit, il faut, pour gérer sa chaîne d'approvisionnement, convaincre ses partenaires (Jun et al. 2000). En ce qui a trait aux technologies qui tissent des liens entre les entreprises, nous nous trouvons alors avec deux possibilités d'adoption : une adoption volontaire ou une adoption forcée. La deuxième possibilité a souvent lieu en présence d'un grand donneur d'ordre ou un client important et d'un plus petit fournisseur influençable. En effet, les petites entreprises semblent particulièrement avoir de la difficulté à adopter des technologies qui permettent l'intégration de la chaîne d'approvisionnement (Pearcy et Giunipero, 2008). C'était le cas avec l'adoption forcée des codes à barres (Wilson et Vlosky, 1998), de l'adoption forcée des systèmes EDI dans l'industrie de l'automobile (Iskandar et al. 2001a; Webster, 1995), de l'adoption forcée des systèmes d'approvisionnement électronique dans l'industrie des métaux primaires (Boeck et al. 2006), de l'adoption forcée des places d'affaires électroniques (Gulledge, 2002) et de l'adoption forcée de la technologie RFID (Williams et Moore, 2007).

Afin de mieux illustrer cette situation, prenons un exemple qui est d'actualité et qui fut hautement médiatisé, celui de l'adoption de la technologie RFID dans la chaîne d'approvisionnement du détaillant américain Wal-Mart. Dans le secteur du détail et des produits de consommations courants où opère Wal-Mart, l'échange de données électroniques ainsi que d'autres formes de systèmes interorganisationnels ont été adoptés afin de fournir un avantage collaboratif. Une récente évolution de ce phénomène est celui de l'utilisation de la technologie RFID. Les avantages évoqués par l'industrie et qui peuvent être conférés par la technologie RFID semblent être nombreux. Les consultants et vendeurs technologiques qui ont un parti pris s'entendent pour dire que cette technologie offre principalement la possibilité d'exercer un meilleur contrôle sur la gestion et la visibilité des produits qui transitent tout au long de la chaîne d'approvisionnement. Plusieurs entreprises ont donc emboîté le pas en débutant des projets pilotes comme ce fut le cas de l'entreprise Wal-Mart. Wal-Mart est en effet convaincu que l'utilisation de la technologie RFID lui permettra d'obtenir un avantage collaboratif sur ses concurrents. Elle a donc mandaté ses fournisseurs à adopter cette technologie en stipulant que tous les joueurs de sa chaîne d'approvisionnement y trouveraient des avantages (RFID Journal, 2003). Cependant, l'entreprise n'a pas spécifié quels seraient ces avantages. Certains fournisseurs de Wal-Mart ont accueilli la nouvelle très positivement et initient leurs propres projets RFID tels Gillette, HP et Unilever. Il semblerait à première vue que la plupart des entreprises peuvent y trouver leurs avantages puisque 34 PME ont fortement manifesté leur désir d'être inclus dans les projets initiaux du géant du détail Wal-Mart.

Cependant, plusieurs fournisseurs de Wal-Mart restent sceptiques et ne font que rencontrer au minimum les exigences imposées par le détaillant, ce qui correspond à un cas d'adoption forcée. Certains fournisseurs tentent même de ralentir cette initiative. Ainsi, il semblerait que tous les joueurs de la chaîne d'approvisionnement de Wal-Mart ne sont pas en accord avec la valeur que cette technologie peut leur conférer.

2.4. Le rôle des pressions coercitives dans l'adoption des systèmes interorganisationnels

Le terme « pressions coercitives » provient des expressions « pressions externes » et « tactiques coercitives » proposées par Iacovou et ses co-auteurs en 1995. Ce terme est repris pour désigner les pressions exercées par certains partenaires de la chaîne d'approvisionnement pour influencer ou même forcer l'adoption des systèmes interorganisationnels. Quoique plusieurs auteurs reconnaissent le rôle de ces partenaires dans l'adoption du commerce électronique (Iacovou et al. 1995; Chwelos et al. 2001) surtout en ce qui a trait aux petites entreprises (Damaskopoulos et Evgeniou, 2003; Chan et Swatman, 2004; Grandon et Pearson, 2004), peu de recherches se consacrent explicitement sur ce phénomène. Dans les paragraphes qui suivent, nous ferons une synthèse des recherches qui ont tenté de comprendre ce phénomène, de le décrire, de l'analyser ou d'évaluer son impact. Cette revue de la littérature permet d'identifier des pistes de recherches. Voici une présentation de trois articles fondamentaux qui ont ouvert la thématique à la recherche et dont plusieurs recherches subséquentes se sont inspirées.

2.4.3. Des réseaux de collaboration ou de conflit?

Webster a publié en 1995 un article intitulé « Networks of collaboration or conflict? EDI and power in the supply chain » dont le propos central avançait l'idée originale que l'utilisation des systèmes interorganisationnels par les entreprises puissantes reflète en réalité leur désir de domination sur les marchés. Son analyse se base sur l'approche de la "sociologie de la technologie" où l'innovation comporte plus que la composante technologique et elle doit alors être considérée dans un environnement économique et politique. L'auteur réfute la croyance généralisée en gestion que les systèmes interorganisationnels contribuent principalement à créer des structures collaboratives et ainsi, permettent aux entreprises de s'éloigner d'un paradigme axé sur la concurrence. Selon cet auteur, il existera toujours un esprit de compétition à l'intérieur d'une chaîne d'approvisionnement, car même dans le cas de projets communs, les entreprises tentent souvent d'usurper une part supérieure des bénéfices tout en évitant leur juste part des coûts. Pour illustrer cette proposition, Webster présente deux industries où des entreprises influentes usent de leur pouvoir pour influer sur l'adoption des systèmes EDI de leurs fournisseurs. Le premier cas provient de l'industrie de l'automobile et vise particulièrement le géant américain Ford qui aurait développé un système interorganisationnel propriétaire pour des fins toutes autres que collaboratives. En réalité, l'objectif de l'entreprise était de développer un verrouillage (« lock-in ») de ses fournisseurs et de ses clients et ainsi augmenter le contrôle qu'elle exerce sur eux. Le deuxième cas qui vient supporter la proposition de Webster est dérivé de l'industrie du détail où le même principe général est présenté avec des joueurs différents. L'implantation du système interorganisationnel par les fournisseurs augmente leurs coûts de transaction mais n'offre que peu de bénéfices directs en retour. Ainsi, quelques fournisseurs se demandent même si continuer la relation en vaut la peine. Les systèmes interorganisationnels ont alors comme objectif caché de créer une intégration verticale virtuelle qui est fortement similaire à l'intégration verticale des entreprises mais sans les obligations financières de les posséder légitimement. Cette affirmation implique que le contrôle du réseau pourrait peut-être être plus avantageux que le posséder. En effet, à quoi bon débourser pour acquérir des entreprises afin d'en posséder leurs ressources lorsqu'on les contrôle déjà? Cette vision est en forte contradiction avec la notion de collaboration avancée par plusieurs auteurs (Spekman et Carraway, 2006) et par les entreprises mêmes qui endossent l'utilisation des systèmes interorganisationnels chez leurs partenaires. Webster conclut que la vision collaborative de partenariat propagée par les entreprises qui encouragent l'utilisation des systèmes interorganisationnels est embellie. L'auteur reconnaît néanmoins que l'impact négatif sur les fournisseurs pourrait être temporaire puisque l'EDI est éventuellement diffusé aux fournisseurs de ces fournisseurs.

Notons qu'une analyse de cet article nous permet d'identifier quelques lacunes et par ce fait, quelques avenues de recherches intéressantes. Premièrement, aucune information sur l'approche méthodologique n'est disponible. Nous ne pouvons donc pas savoir quelles démarches ont été entreprises afin d'obtenir les résultats empiriques. Les exemples présentés, quoique fort intéressants et évocateurs, restent alors des anecdotes potentiellement non fiables. Les arguments, quoique difficilement vérifiables de par le manque de transparence au niveau de la méthodologie de recherche utilisée, semblent tout de même logiques et même raisonnables: le verrouillage peut en effet être une conséquence des systèmes interorganisationnels. Ainsi, les affirmations de Webster lui ont valu d'être repris plusieurs fois dans des travaux académiques subséquents. Deuxièmement, l'article pourrait être critiqué pour avancer une opinion aussi arrêtée sur les raisons des entreprises influentes d'implanter un système interorganisationnel. En effet, l'objectif des systèmes interorganisationnels, tels que présenté dans l'article, frise un dessin manipulateur, voire machiavélique, de la part des entreprises puissantes. L'article ne considère pas les projets de systèmes interorganisationnels dans leur ensemble puisqu'il ne traite que d'une facette très limitée, celle des pressions coercitives et fait fi des synergies collaboratives pouvant découler d'un tel projet. Cependant, le but de l'article était justement de démontrer cette facette plus cachée, plus sombre des projets de systèmes interorganisationnels. Cette vue est extrême et en opposition, comme le dénote d'ailleurs l'auteur, avec l'opinion populaire et le consensus académique en matière d'objectif collaboratif des systèmes interorganisationnels. Cet article a le mérite de « secouer » les lecteurs et d'engager une réflexion plus approfondie sur le sujet.

2.4.4. L'écart entre l'adoption désirée et l'adoption réelle

Les réflexions de Cavaye dans son article intitulé « The sponsor-adopter gap: Differences between promoters and potential users of information systems that link organizations » (Cavaye, 1995) peuvent être appliquées au phénomène des pressions coercitives. L'auteur contribue à l'évolution de la littérature sur l'adoption des systèmes interorganisationnels en proposant une barrière supplémentaire à cette adoption soit l'écart entre les « sponsors » (i.e. entreprises instigatrices) de la technologie et ceux qui doivent l'adopter. Cet écart amène l'existence des pressions coercitives. Ainsi, les sponsors, étant de par leur nature plus innovants, se retrouvent au stade d'implantation de la technologie, tandis que les « adopteurs » (i.e. entreprises incitées) se retrouvent au stade de familiarisation (connaissance de la technologie). Parce qu'ils sont moins avancés dans leur réflexion technologique, ils n'ont pas encore eu assez de temps d'en évaluer les bénéfices. Cette dichotomie crée un gouffre entre les « sponsors » et les « adopteurs » qui cause à son tour une barrière importante à l'adoption des systèmes interorganisationnels. Quoique cette hypothèse semble à priori logique et vraisemblable, l'auteure présente seulement des anecdotes intéressantes mais sans fondement méthodologique

2.4.5. Les systèmes interorganisationnels et les relations interentreprises

Un peu plus tard, Wilson et Vlosky (1998) ont tenté d'examiner l'impact de l'introduction des systèmes interorganisationnels sur les relations interentreprises mais, sans faire référence à l'article de Webster (1995). Les résultats de leur recherche sont présentés dans leur article original intitulé « Interorganizational information system technology and buyer-seller relationships ».

Comme terrain d'étude, ils ont choisi le secteur du détail, et plus particulièrement, celui des centres de rénovation et de leurs fournisseurs de produits de bois. Selon les chercheurs, les pressions coercitives dans ce secteur tirent leurs origines du fait que les détaillants désirent obtenir un avantage compétitif relié aux bénéfices que procurent les systèmes interorganisationnels. Ces avantages, proviennent des stratégies logistiques de juste-à-temps ou de réaction rapide (« quick response ») qui nécessitent un support interorganisationnel offert par l'EDI ou les codes à barres. Ils prétendent que le fournisseur repoussera souvent les pressions coercitives, car il ne perçoit pas la valeur associée à l'implantation du système interorganisationnel. Ceci est dû au fait que le client investit dans un seul système interorganisationnel pour joindre ses fournisseurs, tandis les fournisseurs doivent souvent investir dans plusieurs systèmes pour répondre aux exigences particulières de divers clients. De plus, une différence de perception cause des frustrations entre le client et son fournisseur. Le client trouve que le fournisseur n'est pas suffisamment proactif face à ses demandes tandis le fournisseur se sent pousser à adopter une technologie différente. En réalité, cette frustration est causée par un écart entre les compétences technologiques de chaque joueur. Le résultat est qu'une relation auparavant stable est maintenant déstabilisée par le client influent qui utilise son pouvoir pour influencer le fournisseur. Cependant, la frustration semblerait être un effet secondaire à court terme, puisque souvent le niveau de satisfaction dans la relation dépasse le niveau existant avant l'implantation du système interorganisationnel et ce, au fur et à mesure que les deux organismes perçoivent des bénéfices.

Dans le cas de leur étude, les chercheurs proposent un modèle conceptuel qui puise dans les construits de la littérature du « buyer-seller relationship » avec des construits tels l'engagement, la confiance, la satisfaction de la performance, la comparaison des niveaux d'alternatives mais aussi à partir de la théorie des coûts de transaction avec le construit des investissements non-transférables. De plus, en se basant sur la littérature du pouvoir et des conflits dans les canaux de distribution, les chercheurs utilisent le construit du « pouvoir et de la dépendance » qui est à la base même de leur modèle conceptuel puisque c'est cette variable indépendante qui donne vie au modèle. En effet, selon les chercheurs, une demande d'implanter un système interorganisationnel par le client, cause la variable (auparavant latente) de pouvoir et de la dépendance d'exercer un effet déstabilisant sur les relations interentreprises. Ce phénomène est donc avant tout une démonstration du pouvoir d'un organisme sur un autre. Le cadre conceptuel de cette recherche est présenté à la figure 2.4.

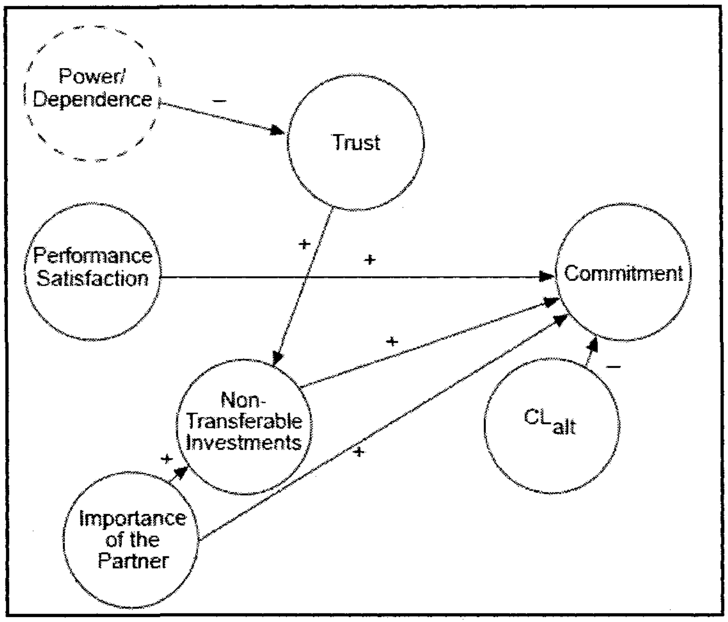

Figure 2.4 : Cadre conceptuel présenté dans Wilson et Vlosky (1998)

Malheureusement, leur sondage a obtenu un taux de réponse plutôt faible et seulement les résultats de 13 fournisseurs de bois et de 22 centres de rénovation ont pu être utilisés. D'un point de vue statistique, les chercheurs n'ont donc pu rencontrer totalement leurs objectifs de recherche, mais ont tout de même conduit des analyses statistiques bivariées en comparant les moyennes des réponses entre les deux groupes (fournisseurs vs centres de rénovation). Ainsi, la comparaison entre ces deux groupes démontre significativement que le processus d'adoption des systèmes interorganisationnels est bel et bien inégal. Les fournisseurs s'attendent et réalisent moins de bénéfices que les clients, qui eux, sont perçus comme ayant plus de pouvoir et étant moins dépendants. Les clients qui pourraient avoir initié les projets de systèmes interorganisationnels ont un engagement plus faible dans la relation à long terme avec leurs fournisseurs mais ont une propension plus élevée à partager des informations avec eux. Étonnamment, la confiance règne de manière égale chez les deux groupes.

Une analyse de cet article révèle aussi d'autres informations pertinentes à l'étude des pressions coercitives. Premièrement, les chercheurs élaborent le concept d'un écart technologique comme source de conflit entre le client et son fournisseur sans toutefois faire référence à Cavaye (1995) qui avait déjà abordé ce thème. Nous pouvons donc supposer que les deux recherches sont arrivées aux mêmes conclusions indépendamment, ce qui sert à augmenter la fiabilité des résultats par triangulation. Cependant, comme Wilson et Vlosky (1998) affirment eux-mêmes, cet élément reste anecdotique dans leur étude. D'autres recherches sont nécessaires pour confirmer la présence de cet écart. Deuxièmement, les traitements statistiques se limitent à des tests bivariés à cause du nombre limité des répondants. Ceci implique que leur modèle conceptuel, quoique fort intéressant, n'a pu être totalement validé.

2.4.6. Autres recherches portant sur les pressions coercitives

D'autres travaux académiques sont depuis venus combler une partie des fondements théoriques portant sur les pressions coercitives dans le contexte de l'adoption de systèmes interorganisationnels. Nous savons maintenant que les pressions coercitives sont surtout appliquées par un client influent et que la force de ce pouvoir est négativement corrélé au volume de transactions engendrées par la relation (Hart et Saunders, 1997). Contrairement à ce que l'on pourrait croire, la taille de l'entreprise ne va pas nécessairement de pair avec son pouvoir. En effet, certaines grandes entreprises se sentent tout de même vulnérables aux pressions coercitives malgré leur taille (Morrell et Ezingeard, 2002). Mais ce pouvoir, même s'il entraîne l'adoption d'un système interorganisationnel par un fournisseur, est-il réellement efficace à long terme? La réponse à cette question provient d'une étude qui a démontré l'efficacité du pouvoir à court terme mais qui a également conclu que la confiance est plus efficace à long terme (Ratnasingam, 2000).

Néanmoins, la théorie de la dépendance envers les ressources suscite beaucoup d'intérêt de la part des chercheurs. Une étude transversale a d'ailleurs démontré que cette théorie est plus appropriée que la théorie des coûts de transaction pour expliquer que les clients forcent l'adoption des systèmes EDI auprès de leurs fournisseurs (Iskandar et al. 2001a). En effet, grâce à une étude qui s'est consacrée à comprendre l'effet des pressions coercitives sur l'adoption (Nagy, 2006), nous constatons que le pouvoir dans les relations interentreprises est essentiel pour expliquer le résultat d'adopter ou non un système interorganisationnel. À titre de démonstration, l'auteur explique que même s'il est dans l'intérêt de tous les joueurs d'une même chaîne de créer une valeur ajoutée pour la chaîne entière, ceux-ci tenteront constamment de se distribuer les gains inégalement. Cette lutte intra-chaîne limite la collaboration et conséquemment l'intégration entre les entreprises. Ainsi, le partenaire détenant le pouvoir influencera l'utilisation ou l'inhibition des systèmes interorganisationnels dans la chaîne. Le facteur de l'inhibition de l'adoption est l'idée originale que nous apporte l'étude de Nagy (2006). Le facteur de l'intention d'adopter est quant à lui essentiel pour déterminer l'adoption d'un système interorganisationnel. Il est évalué grâce à une analyse coûts-bénéfices interne à l'entreprise. Bref, si l'entreprise influente (qu'elle soit un client ou un fournisseur) est suffisamment puissante envers ses partenaires, elle peut, dépendant des avantages qu'elle y voit, soit forcer ou refuser de participer à l'adoption des autres firmes de sa chaîne.

2.4.7. Un récapitulatif de la littérature sur les pressions coercitives

Deux industries semblent avoir été des terrains particulièrement fertiles pour étudier le rôle des pressions coercitives sur l'adoption des systèmes interorganisationnels : l'industrie automobile (Jun et al. 2000; Webster, 1995; Cavaye, 1995; Iskandar et al. 2001b; Kurokawa et Manabe, 2002; Ratnasingam, 2000) et l'industrie du détail (Wilson et Vlosky, 1998, Webster, 1995). De plus, puisque peu de recherches se sont penchées sur les pressions coercitives, cette constatation vient soutenir et justifier l'approche d'une étude de nature exploratoire.

Il serait bénéfique, à ce stade, de regrouper nos assises théoriques afin de faire le point sur nos connaissances au sujet des pressions coercitives et d'identifier les sources théoriques supplémentaires auxquelles nous pourrons puiser suffisamment de connaissances pour pouvoir répondre à notre problématique. Ainsi, nous savons maintenant que les bénéfices (Wilson et Vlosky, 1998) ou le désir de contrôle (Webster, 1995) ont un effet positif sur l'adoption d'un système interorganisationnel. Cependant, le processus décisionnel de l'entreprise instigatrice qui tente d'initier cette initiative est à un stade d'avancement plus élevé, ce qui crée un écart décisionnel (Cavaye, 1995) ou technologique (Wilson et Vlosky, 1998) avec l'entreprise incitée. L'entreprise instigatrice exercera des pressions coercitives pour enclencher le processus d'adoption dans l'entreprise incitée (Iacovou et al. 1995), ce qui pourra en retour engendrer un effet pervers tel qu'une baisse de la qualité de la relation d'affaires (Webster, 1995; Wilson et Vlosky, 1998). Cette pensée peut être et récapituler dans la figure 2.5.

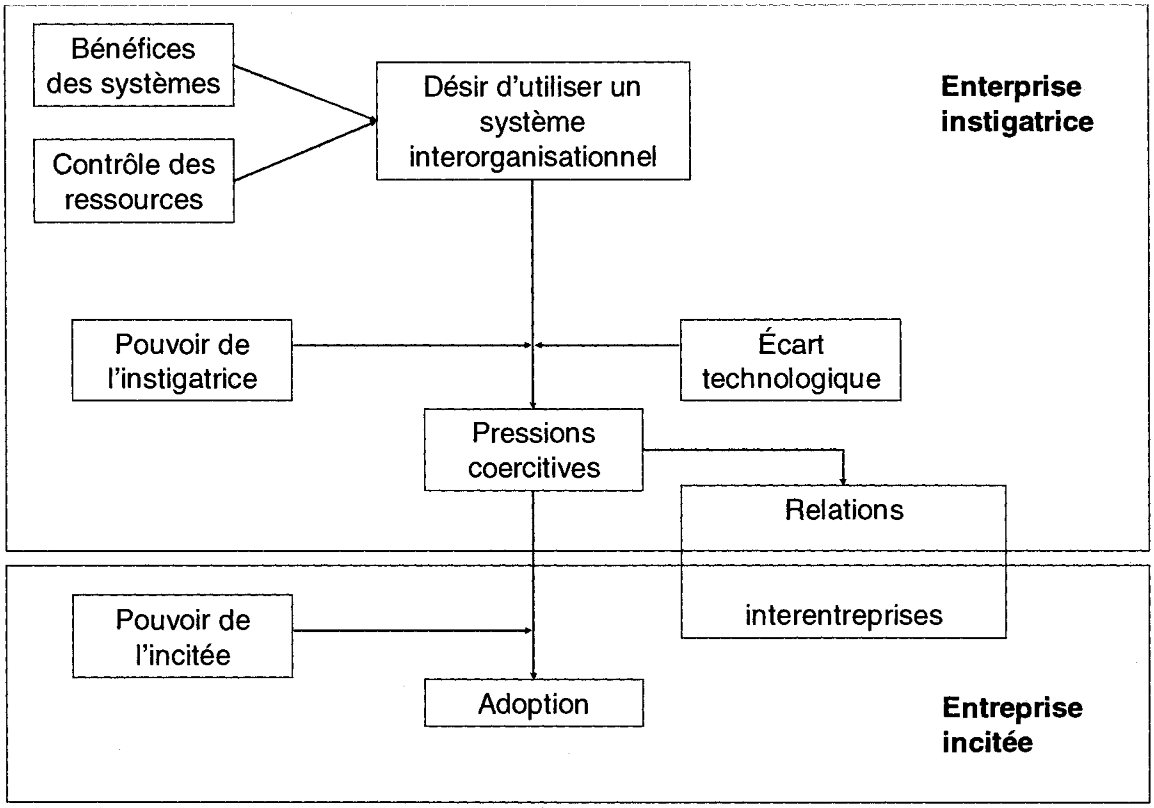

Figure 2.5 : Modèle récapitulant la littérature entourant les pressions coercitives

Dans le schéma de la figure 2.5, la théorie du pouvoir et de la dépendance modère l'amplitude des pressions coercitives exercées (Hart et Saunders, 1997; Morrell et Ezingeard, 2002; Ratnasingam, 2000; Iskandar et al. 2001a) par l'entreprise instigatrice et offre même la possibilité de refuser l'adoption (Nagy, 2006) par l'entreprise incitée.

Malgré que ce modèle soit très éloquent et nous donne plus de compréhension sur le phénomène d'adoption des systèmes interorganisationnels dans le contexte de la chaîne d'approvisionnement, nous en concluons néanmoins que trop peu d'informations existent dans ce champs académique pour que nous puissions baser notre analyse de la problématique sur celle-ci. En effet, plusieurs articles présentent une méthodologie peu académique (Ratnasingam, 2000; Webster, 1995), des études de cas anecdotiques et non généralisables

(Cavaye, 1995; Ratnasingam, 2000; Morrell et Ezingeard, 2002) ou des résultats d'étude peu concluants (Wilson et Vlosky, 1998). Dans la prochaine section, nous élargirons donc notre revue de littérature pour incorporer les différents paradigmes d'adoption afin de pouvoir trouver une base plus solide pour notre analyse et notre discussion.

2.5. Les paradigmes d'adoption

L'utilisation de systèmes interorganisationnels dans le but d'améliorer la gestion de la chaîne d'approvisionnement est avant tout un exercice d'adoption en groupe. Afin de pleinement comprendre ce phénomène, il est essentiel de se pencher sur les théories d'adoption.

2.5.1. La théorie de la diffusion

Incontestablement, parmi les différents modèles d'adoption qui existe, c'est le travail d'Everett Rogers et son modèle de la diffusion des innovations (Rogers, 2003) qui est le mieux connu dans les cercles académiques. À compter de 1962, Rogers représente un auteur incontournable au niveau de la recherche sur l'adoption et la diffusion d'innovations (Hansen, 2006).

Selon Rogers, cinq variables expliquent de 49% à 87% de la variance du taux d'adoption d'une innovation. Elles sont régulièrement utilisées dans les études qui tentent de mesurer ou prédire l'adoption d'une innovation technologique. À titre d'exemple, référons-nous à une étude qui a étudié les facteurs influant sur l'adoption de technologie du télé-travail en se basant sur la théorie de la diffusion émise par Rogers (Choon-Ling Sia et al. 2004). Ces variables sont définies de la manière suivante :

1. *L'avantage relatif* : une innovation est perçue comme étant meilleure que celle qu'elle remplace.
2. *La compatibilité* : une innovation est perçue comme étant compatible avec les valeurs actuelles, l'expérience vécue et les besoins des adopteurs potentiels.
3. *La complexité :* une innovation est perçue comme étant relativement difficile à comprendre et utiliser.
4. *La facilité de l'essai ou testability* : une innovation peut être testée sur une base limitée.
5. *L'observabilité* : les résultats d'une innovation sont visibles aux autres.

Une innovation n'est pas adoptée par tous les individus simultanément. Il existe différentes catégories d'adopteurs que nous pouvons regrouper en fonction de leur propension à innover. Nous retrouvons alors cinq profils qui portent les noms suivants : les innovateurs, les adopteurs précoces, la majorité précoce, la majorité tardive et les retardataires (Rogers, 2003). L'adoption par ces différentes catégories suit une distribution normale telle que présentée à la figure 2.6 et qui pourra être utilisée pour prédire le taux d'adoption anticipée (Bass, 2004).

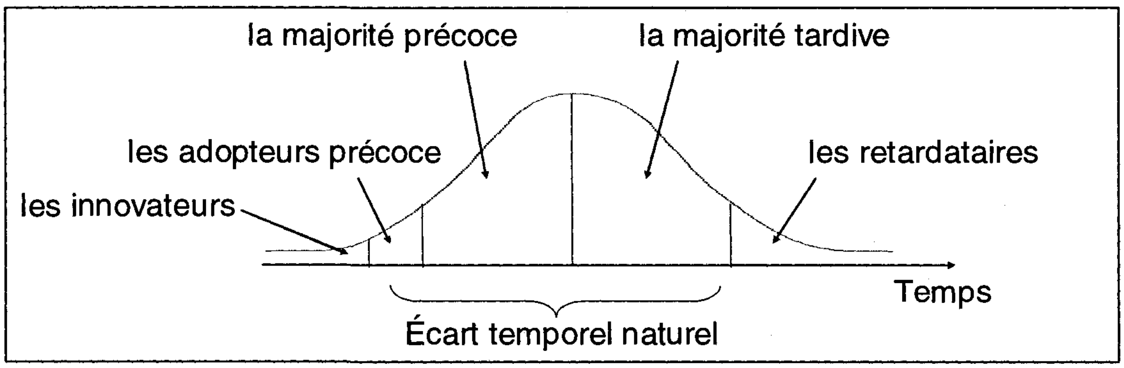

Figure 2.6 : Les catégories d'adopteurs à travers le temps selon le modèle de Rogers

Ce modèle simple et intéressant démontre également l'écart temporel qui existe naturellement entre le moment lorsque les innovateurs et adopteurs précoces adoptent une technologie par rapport au moment lorsque la majorité tardive et les retardataires préféreraient l'adopter (figure 2.6). Cette différence temporelle pourrait expliquer l'écart technologique que certains chercheurs ont dénoté lors de l'étude des pressions coercitives (Cavaye, 1995; Wilson et Vlosky, 1998). Le désir d'entraîner la majorité tardive ou les retardataires dans un processus d'adoption au rythme des innovateurs ou des adopteurs précoces accélèrerait leur démarche naturelle et les mettrait dans une situation d'inconfort.

Notons qu'il ne faut pas confondre l'écart que nous venons de présenter et qui prend sa source de la revue de littérature portant sur les pressions coercitives présentées dans la figure 2.5 avec le gouffre technologique identifié par Geoffrey Moore (Moore, 1999). L'hypothèse du gouffre technologique est peut-être le plus important mythe de la théorie de l'adoption. Elle prend sa source du fait que plusieurs innovations technologiques peinent à atteindre le seuil critique d'adoption suite à quelques essais positifs. Ainsi, Moore affirme qu'un gouffre existe entre les catégories d'adopteurs de sorte que la transition s'effectue mal entre l'adoption par les adopteurs précoces et la majorité précoce. Certes, un tel phénomène viendrait simplifier la vie des gestionnaires de produits en leur permettant d'affirmer que le lancement de nouveau produit échoué provient d'une mauvaise transition entre ces deux catégories d'adopteurs. Néanmoins, la courbe d'adoption prend la forme d'une courbe continue et rien n'indique qu'un tel gouffre technologique existe réellement (Rogers, 2003).

Cependant, même si les théories de Rogers sont utilisées dans un contexte technologique, elles représentent avant tout un modèle d'adoption général (Hansen, 2006) qui n'est pas nécessairement spécifique à notre problématique. En effet, elles s'appliquent aux innovations au sens large que Rogers définit comme étant une idée, une pratique ou un objet qui est perçu comme nouveau par un individu ou tout autre groupe (Rogers, 2003). Or, le phénomène d'adoption étudié dans le présent ouvrage traite surtout d'une situation où le pouvoir exercé par le réseau de l'entreprise joue un rôle central, voir même tout à fait essentiel, pour expliquer le phénomène d'adoption. Dans le modèle de Rogers, les variables du pouvoir et du réseau ne font pas partie des cinq variables principales. Elles sont plutôt amalgamés dans des variables de second rang qui dans leur ensemble ne comptent que pour 13% à 51% de la variance qui explique l'adoption. Le modèle de Rogers ne peut donc, à lui seul, nous fournir tous les éléments de réponses à notre problématique. Il sera donc de mise de pousser notre revue de littérature sur l'adoption plus loin en étudiant des modèles plus précis qui s'appliquent plus spécifiquement à notre problématique. Ainsi, nous nous pencherons dans les prochaines sections du chapitre sur l'influence des pressions externes lors de l'adoption puis sur l'influence des réseaux.

2.5.2. L'institutionnalisme

Quoique le modèle de Rogers soit très bien connu, il s'applique peut-être moins à notre problématique. En effet, dans celui-ci, les facteurs qui mènent un individu ou une organisation à adopter une innovation sont surtout intrinsèques. Or, comme plusieurs l'ont déjà souligné, les facteurs externes à la PME contribuent à une part importante de leur adoption des systèmes interorganisationnels (Damaskopoulos et Evgeniou, 2003; Grandon et Pearson, 2004). De plus, leurs initiatives en la matière sont surtout axées sur des partenaires d'affaires spécifiques (Chan et Swatman, 2004). Curieusement, il y a un manque de recherche à ce sujet (Drew, 2003).

L'institutionnalisme est un paradigme important pour comprendre le comportement des entreprises lors de l'analyse de leur relations interorganisationnelles (Barringer et Harrison, 2000) et, puisque les systèmes interorganisationnels sont utilisés pour tisser des liens entre plusieurs partenaires d'affaires afin de former un réseau, un modèle théorique comme celui de l'institutionnalisme pourrait être plus approprié pour mesurer la propension d'une organisation à adopter des systèmes interorganisationnels (Teo et al. 2003).

L'institutionnalisme tire ses origines des travaux de Dimaggio et Powell (1983) qui ont proposé que les organisations, suite aux pressions exercées, se conforment aux normes sociales présentes dans leur environnement. Teo et ses co-auteurs (2003) furent les premiers à étudier le lien entre les forces institutionnelles et l'adoption des systèmes interorganisationnels. Tel qu'illustré à la figure 2.7, les auteurs se sont basés sur la théorie de l'institutionnalisme (Dimaggio et Powell, 1983) et la découverte de l'importance des pressions externes lors de l'adoption de systèmes EDI (Chwelos et al. 2001).

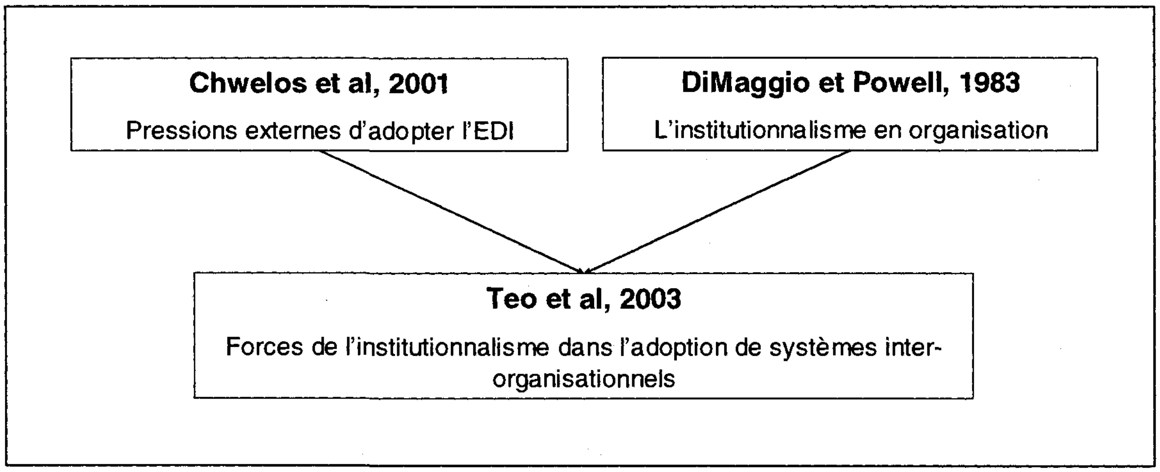

Figure 2.7 : Racines théoriques pour l'article de Teo et al. (2003)

Leur étude mesure l'influence de trois formes institutionnelles sur l'intention d'adopter des systèmes financiers EDI à Singapour. Premièrement, les pressions de mimétisme isomorphisme poussent les organisations à se conformer à leur environnement afin d'y ressembler. Notons d'ailleurs que deux types de mimétismes existent. Dans le premier cas, le mimétisme pousse l'organisation à ressembler à ses pairs qui occupent une place semblable dans un réseau d'entreprises (Burt, 1987). L'entreprise en question s'identifie à ses pairs, car elle partage plusieurs éléments structurels qui s'y apparentent. Le deuxième cas de mimétisme est celui qui fait appel au désir d'imiter les actions des leaders de l'industrie (Haveman, 1993). Les organisations empruntent peut-être le chemin du mimétisme afin de limiter les coûts reliés aux études (Cyert et March, 1992) ou ceux reliés à l'expérimentation (Levitt et March, 1998). Elles ne font pas appel à un processus de rationalité optimale, mais plutôt de rationalité limitée (Simon, 1997) leur permettant ainsi de se fier aux agissements de leurs pairs. Deuxièmement, les pressions normatives tirent leur origine du réseau auquel la firme appartient et des organisations en contact direct avec la firme en question. Par le simple contact et les liens de communication, les entreprises s'influencent mutuellement. Ces forces peuvent être observées par le lien interorganisationnel lorsque l'unité d'analyse est la dyade (Burt, 1982). Troisièmement, les pressions coercitives qui proviennent des sources d'influence externes à l'entreprise visent à influencer son comportement.

Plusieurs études ont déjà prouvé l'importance de l'institutionnalisme dans l'adoption de l'EDI (Chwelos et al. 2001). Les résultats de la recherche ont, en effet, démontré le rôle des forces institutionnelles dans l'intention d'adopter des systèmes interorganisationnels. Ainsi, les pressions normatives représentaient la plus forte influence suivie par les pressions coercitives et le mimétisme (Teo et al. 2003).

Nous retenons donc qu'il est important de considérer les pressions externes à l'entreprise dans notre modèle théorique pour expliquer l'adoption des systèmes interorganisationnels. La théorie de la diffusion de l'innovation de Rogers, qui se concentre surtout sur des facteurs de décisions intrinsèques à l'entreprise, n'est pas suffisante et doit, dans ce cas-ci, être complétée par l'approche de l'institutionnalisme.

2.5.3. L'adoption par les réseaux

La théorie des réseaux sociaux, qui a connu une croissance exponentielle dans la littérature académique (Borgatti et Foster, 2003), se consacre à l'analyse et l'interprétation du rôle qu'occupent les individus ou organisations dans un réseau et les liens qui existent entre eux. Un concept fort important de cette théorie est celui de l' « embeddness » social qui considère que les actions économiques font partie d'un ensemble social dont elles ne peuvent être dissociées (Granovetter, 1985). Considérer ce facteur nous mène à réaliser qu'une logique entièrement différente guide les transactions économiques qui bénéficient de relations répétitives (Uzzi, 1997) telles que celles retrouvées dans une chaîne d'approvisionnement. Après tout, celle-ci est un réseau d'entreprises qui collaborent dans le but de fournir un produit, un service ou une information aux consommateurs et forment, par ce fait, un réseau social.

Dans un contexte d'adoption, la théorie des réseaux sociaux nous aide à comprendre la vitesse et l'efficacité à laquelle une idée sera diffusée à l'intérieur d'un réseau (Rogers, 2003). Elle s'imbrique également dans le concept des pressions normatives de l'institutionnalisme qui proviennent du réseau auquel la firme appartient. De plus, emprunter cette approche implique qu'une vue de l'entreprise prise de manière isolée ne pourrait contribuer pas à notre pleine compréhension (Gulati et al. 2000) et qu'il est important de considérer le facteur du réseau afin de pleinement comprendre le comportement et les performances des entreprises (Ranjay Gulati , 1998). Cette notion est fort importante pour l'étude de notre problématique.

Dans une revue de littérature effectuée sur la théorie des réseaux (Borgatti et Foster, 2003), quatre grandes typologies de recherche portant sur les conséquences des réseaux sont identifiées : le capital structurel, l'accès aux ressources, la convergence et la contagion. Deux d'entre elles visent à étudier le phénomène de l'adoption et de la diffusion. Premièrement, *la convergence* se base sur la structure même du réseau où les entreprises adoptent les comportements d'entreprises qui occupent une place similaire dans un autre réseau non connecté à l'entreprise. Cette approche place beaucoup d'importance à la position de la firme pour en expliquer son comportement. Elle s'apparente au concept de mimétisme de l'institutionnalisme qui pousse les organisations à se conformer à leur environnement afin d'y ressembler. Deuxièmement, *la contagion* se base plutôt sur les connexions établies à l'intérieur du réseau puisque la proximité des groupes avec lequel l'individu ou l'organisation a des contacts l'influence par leur proximité et les échanges communicationnels. Ainsi, une conséquence des réseaux est l'imitation (Brass et al. 2004). Un réseau étant composé de liens communicationnels entre entreprises de confiance, il est tout à fait logique de penser que ces communications influenceront le comportement de la firme. Cette approche se rapproche plutôt du concept des relations interentreprises étudiées en marketing.

Nous retiendrons de la théorie des réseaux sociaux que l'étude de la structure d'un réseau et des connexions qui la composent sont des éléments essentiels à considérer dans l'analyse de notre problématique. En plus des paradigmes d'adoption que nous avons considérés, il est important de s'attarder sur les recherches précédentes qui se consacrent spécifiquement à l'adoption des technologies de commerce électronique par des entreprises généralement plus influentes, c'est-à-dire les petites et moyennes entreprises. Ainsi, la prochaine section de notre revue de littérature nous démontrera que le processus d'adoption n'est pas un processus discret, mais plutôt, celui-ci consiste en un continuum évolutif d'étape d'adoption.

2.6. L'évolution du commerce électronique dans les entreprises

La recherche sur l'évolution de l'utilisation du commerce électronique, qui dans notre contexte est une forme de système interorganisationnel, provient de trois grandes tendances théoriques, soit celle des stades d'adoption (Gibson et Nolan, 1974), des niveaux d'intégration (Venkatraman, 1994) et des trajectoires technologiques (Dosi, 1982; Dosi, 1988). La figure 2.8 dépeint ces tendances ainsi que quelques ouvrages qui en découlent. Les prochains paragraphes les présentent avec plus de détails.

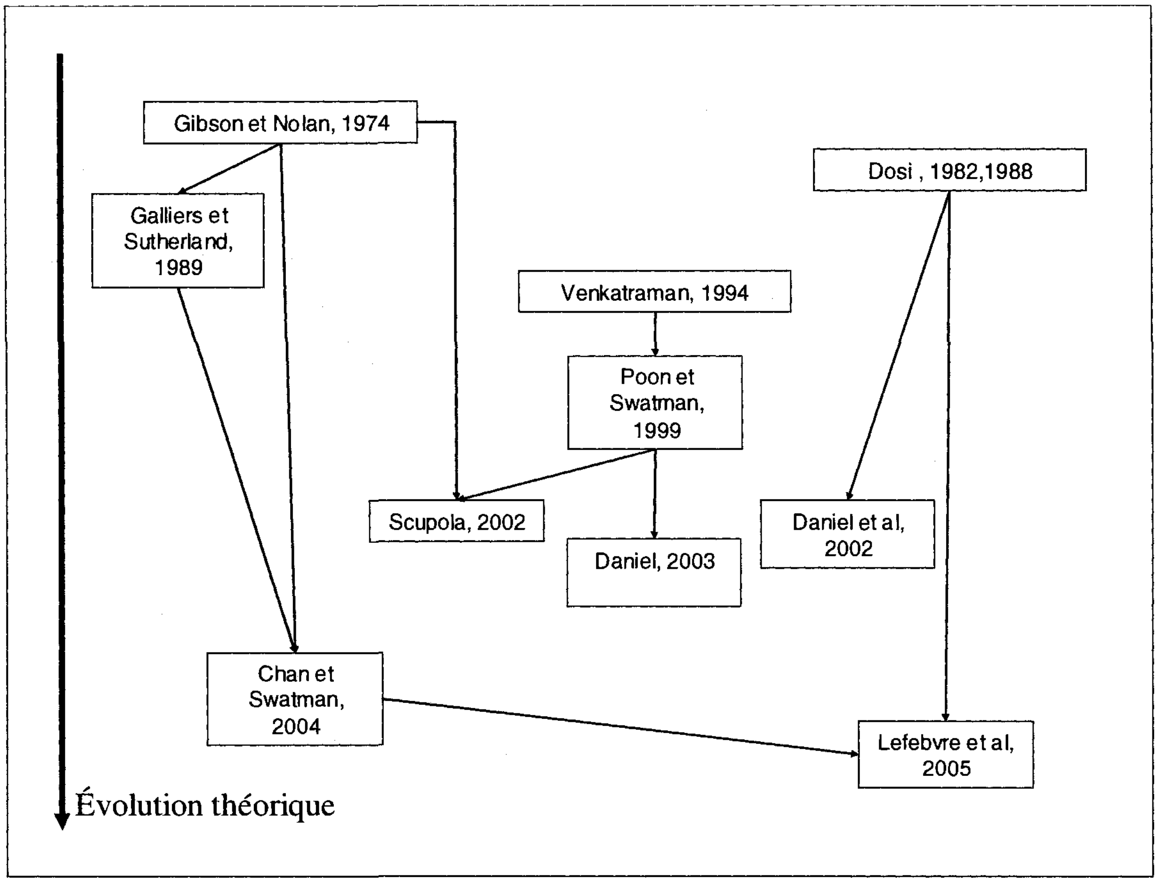

Figure 2.8 : Les paradigmes d'évolution du commerce électronique dans les entreprises

2.6.1. Les stades d'adoption

La première école de pensée est apparue lors de l'étude des premiers systèmes d'information et prend la forme d'un modèle de croissance par stade (Nolan, 1973). La théorie originale des stades de croissance en informatique est apparue en 1973 et était basée sur une courbe d'apprentissage des budgets informatiques (Scupola, 2003; Nolan et Bennigson, 2003). Cependant, ce sont plutôt les articles du même auteur qui ont été publiés par la suite (Gibson et Nolan, 1974; Nolan, 1979) et qui appliquaient la théorie à l'apprentissage organisationnel qui ont le plus retenu l'attention.

De manière générale, les stades de croissance représentent une série d'étapes de développement dont le passage d'un stade est obligatoire ou facultatif pour l'étape subséquente. Une analogie des stades obligatoires peut être faite avec le développement humain où chaque adulte a d'abord passé par le stade de la naissance, le stade de bébé, puis le stade de l'enfant à celui de l'adolescence pour finalement arriver au stage adulte tandis qu'une analogie des stades facultatifs peut être fait avec l'eau où sa forme liquide peut se transformer en vapeur, mais où la glace peut directement se sublimer en vapeur sans transiter par l'état liquide. Dans ce cas, on peut également faire référence à un « état » plutôt qu'un « stade ».

Généralement, l'approche de développement par stade implique une utilisation de plus en plus accrue du commerce électronique par les entreprises. Dépendant du modèle, le nombre et le type de stades varient. Par exemple, l'approche initiale (Gibson et Nolan, 1974) développée pour représenter les stades de croissance des systèmes d'information à l'intérieur de l'entreprise comportait quatre stades dont celle de l'initiation de projet, l'adaptation, la rationalisation et la diffusion technologique. Ce modèle a par la suite été amélioré en y ajoutant les stades d'intégration et de gestion des données (Nolan, 1979) pour en arriver à un modèle de six stades qui a lui aussi été repris dans un contexte commerce électronique (Chan et Swatman, 2004).

Puisque ce paradigme est celui qui est le plus utilisé parmi les trois, nous nous attarderons plus longtemps à en expliquer son évolution théorique plus en détails. La figure 2.9 présente ainsi un modèle plus détaillé que celui présenté dans la figure 2.8. Ajoutons ainsi un article pivot souvent cité qui est celui de Galliers et Sutherland (1989) et qui reprend le modèle classique sur la théorie des stades d'adoption tout en lui ajoutant une dimension organisationnelle et managériale. Selon (Chan et Swatman, 2004), l'article critique également d'autres modèles, tel celui de Earl (1989) qui présente des stades sans spécifier comment une entreprise peut évoluer à l'intérieur de ceux-ci. Ils utilisent alors le modèle managérial des 7S présenté par Pascale et Athos (1981) afin d'analyser les caractéristiques organisationnelles des entreprises pour chacun des six stades qu'ils ont développés.

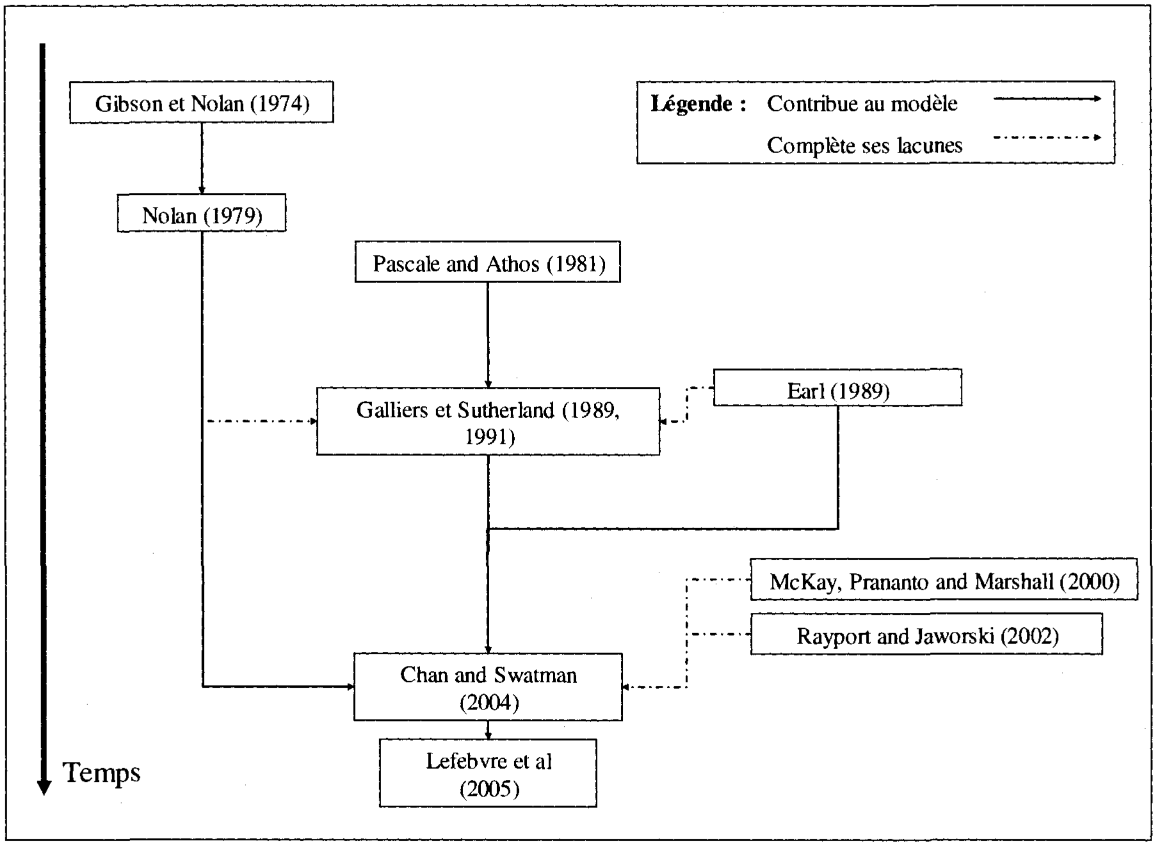

Figure 2.9 : Une évolution de la théorie des stades d'adoption du commerce électronique

Plus récemment, d'autres auteurs (Chan et Swatman, 2004) se sont basés sur les modèles de stades (Nolan, 1979; Galliers et Sutherland, 1989; Earl, 1989) afin de les appliquer aux technologies Internet. Certains modèles traitant de ces technologies existaient déjà (McKay et al. 2000; Rayport et Jaworski, 2002) mais ceux-ci traitaient les initiatives Internet de commerce électronique différemment des autres technologies de commerce électronique tel l'EDI. En utilisant une seule étude de cas suivie par de multiples études de cas afin d'obtenir la généralisation, les auteurs ont développé un modèle comportant quatre stades de croissance : le commerce électronique initial, le commerce électronique centralisé, la perspective interne pour trouver les bénéfices et puis, le commerce électronique global.

Il n'en fallait pas plus pour appliquer le modèle de croissance aux PME qui adoptent les systèmes interorganisationnels. Grâce au stade de croissance appliqué au commerce électronique (Chan et Swatman, 2004) et à la théorie des trajectoires technologiques que nous verrons sous peu (Dosi, 1982), tous les facteurs étaient réunis pour appliquer les stades d'évolution aux PME et de démontrer leur existence à des données quantitatives (Lefebvre et al. 2005b).

2.6.2. Les niveaux d'intégration

Le deuxième fondement théorique qui explique l'évolution du commerce électronique dans les entreprises est celui des niveaux d'intégration. Ce modèle hautement cité présente cinq niveaux possibles à la transformation que l'entreprise subit lorsqu'elle intègre les technologies de l'information à sa structure (Venkatraman, 1994). Puisque chaque niveau confère ses propres bénéfices et coûts, l'entreprise devra préalablement identifier son niveau d'intégration idéale, puis, augmenter ce niveau d'intégration lorsque exigé par la donne du marché. Ce paradigme théorique diffère de celui des stades de croissance par le fait qu'il présente une vision beaucoup plus intégratrice d'une technologie qui transforme la structure de l'entreprise. Ainsi, la littérature sur les stades d'adoption et celle sur les niveaux d'intégration est souvent distincte. De plus, Venkatraman est très explicite sur le fait que les cinq niveaux ne devraient pas être conceptualisés comme étant des stades d'évolution car les stratégies ne suivent pas un seul modèle en particulier (Daniel, 2003). Néanmoins, Venkatraman présente tout de même un phénomène d'évolution technologique puisqu'il conçoit ses niveaux comme une hiérarchie (Daniel, 2003).

L'évolution de cette pensée a pris un tournant vers les systèmes interorganisationnels lorsque des auteurs ont appliqué le modèle aux technologies Internet (Poon et Swatman, 1999). Ces auteurs, ne faisant pas de lien avec les recherches précédentes sur les stades d'adoption de Gibson et Nolan, ont effectué une étude auprès de 23 PME afin d'identifier trois niveaux d'intégration utilisant la technologie Internet. Ces niveaux d'intégration vont de minimum, limité et complet. Leurs conclusions présentent un modèle inversé qui suggère que le modèle conventionnel d'intégration technologique s'inverse lorsqu'on considère les technologies de commerce électronique. Ainsi, l'intégration des technologies à l'interne s'effectue suite à l'intégration des systèmes interorganisationnels avec les partenaires commerciaux.

Poon et Swatman (1999) ont proposé une hiérarchie des niveaux de l'intégration du commerce électronique, mais c'est Daniel (2003) qui l'a validée. Ce chercheur a effectué un sondage auprès de PME pour obtenir 678 questionnaires utilisables. Suite à des analyses de groupement et des analyses de la variance, trois niveaux d'intégration ont été identifiés. Le premier niveau est celui de l'utilisation des systèmes interorganisationnels; le second, celui d'un niveau d'intégration limitée avec les systèmes internes et; le troisième, celui de l'intégration complète. L'auteur a aussi confirmé que les bénéfices augmentent avec l'intégration technologique des entreprises tout en constatant que le niveau de changement des processus d'affaires est indépendant du niveau de l'intégration technologique.

Parmi les rares auteurs qui s'aventurent à tisser un lien entre le paradigme des stades de croissance et celui des niveaux d'intégration, il y a Scupola (2002) qui se base sur les travaux de Gibson et Nolan (1974) et Poon et Swatman (1999). Son étude fut effectuée sur cinq PMEs adopteurs précoces des sites Web.

2.6.3. Les trajectoires technologiques

La dernière grande tendance théorique au niveau de l'évolution du commerce électronique est celle des trajectoires technologiques (Dosi, 1982; Dosi, 1988). Ce modèle tente d'expliquer la trajectoire linéaire ou non que prennent certaines innovations. Certains auteurs attribuent l'acquisition d'expériences et de connaissances effectuée par une séquence d'étapes ou de stades à ce modèle (Daniel et al. 2002; Lefebvre et al. 2005b). Parce que le premier article cité (Daniel et al. 2002) reprend l'étude déjà présentée dans une autre article (Daniel, 2003), nous ne nous tarderons pas à expliquer sa démarche méthodologique. Sachons simplement que les auteurs concluent que l'analyse de groupement a également permis de déterminer que les PME adoptent le commerce électronique par des stades séquentiels où chaque stade fournit des bénéfices et des expériences qui seront utilisées lors des stades subséquents. Une autre étude est arrivée à des conclusions semblables en utilisant une méthodologie complètement différente et en proposant des nouveaux stades : la recherche d'information et la création de contenu électronique (Electronic information search & content creation), les transactions électroniques (Electronic transactions), les transactions électroniques complexes (Complex electronic transactions) et la collaboration électronique (Electronic collaboration).(Lefebvre et al. 2005b). Celle-ci a débuté par l'utilisation de preuves de concept, de groupes de discussion et d'une approche Delphi pour ensuite effectuer un sondage électronique qui fut complété par des entrevues en profondeur lors d'études de cas. Les deux articles (Daniel et al. 2002; Lefebvre et al. 2005b) tout en se reposant sur des approches bien différentes auprès d'un échantillonnage différent arrivent, à démontrer la pertinence de la théorie des trajectoires technologiques.

2.6.4. L'influence des pressions coercitives dans les stades d'adoption

Les grandes tendances théoriques sur l'évolution du commerce électronique dans les entreprises considèrent surtout des facteurs internes pour expliquer cette évolution. Les études précédentes ont tenté d'expliquer comment l'adoption évolue à l'intérieur de l'organisation (Muffatto et Payaro, 2004; Chan et Swatman, 2004) et plus spécifiquement dans les PME (Chaston et al. 2001) en utilisant différentes bases pour établir les stades, que ce soit par une approche technologique (Muffatto et Payaro, 2004), par l'adoption de processus d'affaires électroniques (Lefebvre et al. 2005b; Daniel et al. 2002) ou par un niveau d'intégration (Poon et Swatman, 1999; Daniel, 2003). Il y a également certains auteurs qui réfutent cette approche en proposant que les entreprises adoptent selon un processus non linéaire (Fillis et al. 2004) ou par la chance (Scupola, 2002).

Cependant, aucun de ces modèles n'a tenté d'expliciter le rôle des influences externes dans les stades d'adoption quoiqu'elles soient reconnues comme un des déterminants de l'adoption du commerce électronique par les PME (Damaskopoulos et Evgeniou, 2003; Grandon et Pearson,2004). et que les clients importants aient un impact réel sur l'adoption des systèmes interorganisationnels par leurs fournisseurs (Chwelos et al. 2001). Ainsi, notre analyse ne pourrait être considérée complète sans que nous nous attardions quelque peu sur les études portant sur le lien entre les relations interentreprises et l'adoption des systèmes interorganisationnels.

2.7. Le lien entre les relations interentreprises et l'adoption des systèmes interorganisationnels

Jusqu'à tout récemment, l'importance des relations interentreprises était négligée quant à son potentiel stratégique de créer de la valeur entre les entreprises. Auparavant, les deux principales sources d'avantages compétitifs étaient l'industrie et les ressources tandis que le l'avantage relationnel a été introduit plus tard (Dyer et Singh, 1998). Il est essentiel de considérer les relations interentreprises dans l'étude de notre problématique car elles représentent la clef qui nous permettra de comprendre les pressions coercitives imposées lors de l'adoption des systèmes interorganisationnels.

Le Tableau 2.1 présente les liens qui existent entre les systèmes interorganisationnels et huit dimensions clés qui caractérisent les relations interentreprises. Ce tableau est organisé de la manière suivante. Chaque dimension est définie dans la deuxième colonne suite à l'adaptation d'une ou plusieurs définitions puisées à partir d'une revue de littérature. La troisième colonne présente un résumé des liens qui ont été identifiés entre différents systèmes interorganisationnels et les relations interentreprises. Ces liens sont présentés dans un premier lieu en fonction du type de système interorganisationnel étudié puis, dans un second lieu, en ordre chronologique. Ainsi, les premiers liens présentés seront ceux trouvés à partir des études effectuées sur les technologies EDI puis, celle des systèmes de codes à barres, des technologies Internet telles l’extranet, l'approvisionnement électronique et les places d'affaires électroniques puis, des technologies d'identification par fréquence-radio.

Tableau 2.1 : Liens qui existent entre les systèmes interorganisationnels et huit dimensions clés des relations interentreprises

Dimensions clés des relations interentreprises	Définition	Le lien entre les systèmes interorganisationnels et les dimensions clés des relations interentreprises
La communication et le partage d'information	La quantité, fréquence et qualité du flux d'informations entre les partenaires d'affaires (Palmatier et al. 2006)	La technologie EDI altère la relation ce qui peut engendrer une meilleure coordination dans le flux de l'information (O'Callaghan et al. 1992) Une meilleure communication avec ses partenaires d'affaires représente le plus important facteur stratégique de motivation pour adopter la technologie EDI (Reekers et Smithson, 1994) * Une amélioration de l'exactitude de l'information est perçue comme un avantage majeur découlant de la technologie EDI (Ramaseshan, 1997) * Les partenaires d'affaires qui utilisent la technologie EDI partagent plus d'informations rapidement (Dupuy et Vlosky, 2000) * Les codes à barres tissent des liens entre les systèmes d'information et encouragent le partage de l'information (Manthou et Vlachopoulou, 2001) * Les partenaires qui utilisent un Extranet échangent plus d'informations de meilleure qualité (Vlosky et al. 2000) *

Tableau 2.1 : Liens qui existent entre les systèmes interorganisationnels et huit dimensions clés des relations interentreprises (suite)

Dimensions clés des relations interentreprises	Définition	Le lien entre les systèmes interorganisationnels et les dimensions clés des relations interentreprises
La communication et le partage d'information	La quantité, fréquence et qualité du flux d'informations entre les partenaires d'affaires (Palmatier et al. 2006)	Les utilisateurs d'Internet tendent à communiquer avec leurs fournisseurs et clients plus fréquemment en utilisant des modes de communication traditionnelle que les non-utilisateurs d'Internet (Boyle, 2001) * Les technologies d'approvisionnement électronique augmentent les fréquences de communication entre les partenaires d'affaires (Carr et Smeltzer, 2002) * Les places d'affaires électroniques améliorent les activités de coordination et augmentent la vitesse de partage de l'information (Murtaza et al. 2004)
La coopération	Le désir d'entreprendre des actes afin d'obtenir des objectifs communs (Palmatier et al. 2006; Wilson, 1995)	L'investissement initial de la technologie EDI devrait être supporté par les deux entreprises (O'Callaghan et al. 1992) * Dans une situation de faible dépendance, il y a le risque que le niveau de coopération dans une relation d'affaires soit compromis par l'imposition d'un système EDI (Iacovou et al. 1995) * Un système Extranet implique un niveau considérable de partage d'informations (Vlosky et al. 2000) * Les places d'affaires électroniques peuvent faciliter la

Tableau 2.1 : Liens qui existent entre les systèmes interorganisationnels et huit dimensions clés des relations interentreprises (suite)

Dimensions clés des relations interentreprises	**Définition**	**Le lien entre les systèmes interorganisationnels et les dimensions clés des relations interentreprises**
		collaboration des fournisseurs avec leurs clients (Gulledge, 2002; Howard et al. 2006; Lancastre et Lages, 2006) *
La confiance	La certitude que le partenaire d'affaires maintiendra ses engagements et agira dans les meilleures intentions de son partenaire (Palmatier et al. 2006; Wilson, 1995)	La technologie EDI tend à promouvoir une relation interentreprises à long terme qui peut mener à une confiance mutuelle (Sriram et Banerjee, 1994) * Dans une situation de faible dépendance, il y a le risque que le niveau de confiance dans une relation d'affaires soit compromise par l'imposition d'un système EDI (Iacovou et al. 1995) * La confiance sur laquelle est elle est bâtie la relation n'est pas facilement mise à l'épreuve par des systèmes interorganisationnels de type EDI (Wilson et Vlosky, 1998) * La plupart des répondants ont confiance envers les partenaires d'affaires avec qui ils utilisent un système Extranet (Vlosky et al. 2000) * L'adoption d'un système d'approvisionnement électronique n'est pas liée à la confiance entre les partenaires d'affaires (Carr et Smeltzer, 2002) *

Tableau 2.1 : Liens qui existent entre les systèmes interorganisationnels et huit dimensions clés des relations interentreprises (suite)

Dimensions clés des relations interentreprises	Définition	Le lien entre les systèmes interorganisationnels et les dimensions clés des relations interentreprises
		Les places d'affaires électroniques peuvent contribuer à bâtir la confiance (Ratnasingam, 2005) *
L'engagement	Un désir persévérant d'assurer que la relation continue (Palmatier et al. 2006; Wilson, 1995)	Des investissements spécifiques dans la technologie EDI imposent des barrières à à la sortie qui prennent la forme de coûts de transfert élevés (O'Callaghan et al. 1992) La mise en place d'un système sophistiqué d'EDI entre les entreprises reflète un engagement significatif dans la relation (O'Callaghan et al. 1992) Les partenaires d'affaires qui utilisent les systèmes EDI se sentent généralement engagés à des relations à long terme (Dupuy et Vlosky, 2000) * Les partenaires d'affaires qui utilisent les systèmes EDI perçoivent qu'ils entretiennent une relation privilégiée à long terme (Dupuy et Vlosky, 2000) * La satisfaction d'un client envers l'utilisation d'une technologie de communication par un fournisseur, telle la technologie EDI, affecte indirectement son intention de transiger avec le fournisseur dans le futur (MacDonald et Smith, 2004) *

Tableau 2.1 : Liens qui existent entre les systèmes interorganisationnels et huit dimensions clés des relations interentreprises (suite)

Dimensions clés des relations interentreprises	Définition	Le lien entre les systèmes interorganisationnels et les dimensions clés des relations interentreprises
L'engagement	Un désir persévérant d'assurer que la relation continue (Palmatier et al. 2006; Wilson, 1995)	Les entreprises envisagent augmenter les ventes ou achats futurs avec leurs partenaires d'affaires qui utilisent un système Extranet (Vlosky et al. 2000) * Il pourrait être dommageable pour une entreprise de couper les liens avec un partenaire d'affaires qui utilise un système Extranet (Vlosky et al. 2000) * Il y a une association positive entre l'engagement d'un fournisseur et l'utilisation efficace d'Internet par un client (Boyle, 2001) * Les systèmes d'approvisionnement électronique procurent une transparence de l'information accrue ce qui peut mener à une sous-traitance plus élevée, une réduction de la base de fournisseurs, des développements de partenariat, et des contrats de fournisseurs à long terme (Croom, 2000) Les systèmes d'approvisionnement électroniques mènent à une réduction de la base de fournisseurs (Stump et Sriram, 1997; Boeck et al. 2006) * Les places d'affaires électroniques sont associées à une réduction de la base de fournisseurs (White et Daniel, 2004) *

Tableau 2.1 : Liens qui existent entre les systèmes interorganisationnels et huit dimensions clés des relations interentreprises (suite)

La valeur de la relation	La différence entre les bénéfices et les sacrifices de tout les aspects de la relation (Walter et al. 2000)	La technologie EDI a la caractéristique de procurer des bénéfices significatifs aux deux membres de la dyade (O'Callaghan et al. 1992) * Les adopteurs des codes à barres subissent un bouleversement à court terme qui se transforment en une relation plus solide à long terme (Vlosky et Wilson, 1994) * Les systèmes d'approvisionnement électronique augmentent le volume des ventes disponibles aux fournisseurs survivants et fournissent une relation d'affaires plus serrée (Stump et Sriram, 1997) * Le type de places d'affaires électroniques influence la création de la valeur dans la relation (Hartmann et al. 2002) * L'utilisation des places d'affaires électroniques permet des relations plus serrées avec les fournisseurs qui restent (White et Daniel, 2004) *
Le déséquilibre du pouvoir et l'interdépendance		La firme « source » tente d'induire l'adoption de la technologie EDI dans la firme « cible » (O'Callaghan et al. 1992) * Les clients et les fournisseurs sont reconnus pour encourager l'adoption de la technologie EDI (Sriram et Banerjee, 1994) *

Tableau 2.1 : Liens qui existent entre les systèmes interorganisationnels et huit dimensions clés des relations interentreprises (suite)

Le déséquilibre du pouvoir et l'interdépendance	L'habilité d'un partenaire d'affaires d'influencer l'autre partenaire à faire quelque chose qu'il ne ferait pas normalement (Anderson et Weitz, 1989)	Les clients influents peuvent forcer l'adoption de la technologie EDI chez leurs fournisseurs (Webster, 1995)* La plus importante variable pour expliquer ce qui influence les PME à adopter un système EDI est la pression externe qu'elles reçoivent de la part des « initiateurs » de l'EDI (Iacovou et al. 1995) * Les grandes entreprises perçoivent que leur pouvoir pourra influencer l'utilisation de la technologie EDI dans leur organisation (Ramaseshan, 1997) * Les clients poussent les fournisseurs à adopter des systèmes interorganisationnels tels la technologie EDI et les codes à barres (Wilson et Vlosky, 1998) * Les entreprises croient qu'elles acquiescent trop facilement aux demandes EDI de leurs partenaires (Dupuy et Vlosky, 2000) * La pression externe est un facteur considérablement plus important que les bénéfices perçus pour prédire l'intention d'adopter le système EDI (Chwelos et al. 2001) * Le processus d'adoption des systèmes EDI est significativement géré par le pouvoir présent dans les relations interentreprises (Iskandar et al. 2001a) *

Tableau 2.1 : Liens qui existent entre les systèmes interorganisationnels et huit dimensions clés des relations interentreprises (suite)

		Les fournisseurs qui adoptent les codes à barres croient que leurs clients sont en quelque sorte dépendants d'eux à cause d'une pénurie de produits étiquetés par des codes à barres de type UPC (Vlosky et Wilson, 1994) * Le pouvoir ne semble pas se manifester chez les utilisateurs d'Extranet (Vlosky et al. 2000) * Un léger niveau de dépendance se manifeste à cause de la difficulté de remplacer un partenaire qui utilise le système Extranet (Vlosky et al. 2000) * Les grands clients se mettent en équipe pour former des places d'affaires électroniques (Gulledge, 2002) *
L'adaptation	Les modifications comportementales ou organisationnelles effectuées par une organisation afin de rencontrer les besoins spécifiques d'une autre organisation (Brennan et al. 2003)	Les firmes « cibles » ajustent leurs systèmes internes pour permettre une interface EDI avec la firme « source » (O'Callaghan et al. 1992) Les grands fournisseurs peuvent également forcer l'adoption des technologies EDI (Webster, 1995) * Les fournisseurs font des efforts pour s'adapter aux demandes EDI de leurs clients (Wilson et Vlosky, 1998) * Les entreprises doivent modifier leurs procédures corporatives afin d'accommoder la technologie EDI (Dupuy et Vlosky, 2000) *

Tableau 2.1 : Liens qui existent entre les systèmes interorganisationnels et huit dimensions clés des relations interentreprises (suite)

L'adaptation	Les modifications comportementales ou organisationnelles effectuées par une organisation afin de rencontrer les besoins spécifiques d'une autre organisation (Brennan et al. 2003)	Les fournisseurs qui ont adopté les codes à barres font fait des investissements significatifs en temps et en argent afin de satisfaire les exigences de leurs clients (Vlosky et Wilson, 1994) * Il y a un léger besoin de modifier les procédures d'affaires pour s'adapter aux exigences des partenaires qui utilisent un système Extranet (Vlosky et al. 2000) * L'adaptation des fournisseurs aux systèmes d'approvisionnement électronique et aux places d'affaires électroniques s'effectue par un processus itératif qui est basé sur le niveau des la relations interentreprises (Boeck et al. 2006) *
Le conflit	Le niveau général de mésentente entre les partenaires d'affaires (Palmatier et al. 2006)	La compétition, qui continue de se manifester dans la chaîne d'approvisionnement, mène à des implantations coercitives de la technologie EDI et engendre le conflit (Webster, 1995) Les fournisseurs réagissent de manière défensive aux exigences EDI des clients (Wilson et Vlosky, 1998) * La différence entre la perception des clients et des fournisseurs dans la valeur des produits munis de codes à barres contribue significativement à la détérioration de leur

Tableau 2.1 : Liens qui existent entre les systèmes interorganisationnels et huit dimensions clés des relations interentreprises (suite et fin)

Le conflit	Le niveau général de mésentente entre les partenaires d'affaires (Palmatier et al. 2006)	relation à court terme (Vlosky et Wilson, 1994) * Les fournisseurs ont l'impression que leur clients n'apprécient pas les défis auxquels ils font face pour s'adapter aux requêtes d'utiliser des codes à barres (Vlosky et Wilson, 1994) * Les PME offrent parfois une forme de résistance aux places d'affaires électroniques (Gulledge, 2002) *

* Supporté par des résultats empiriques

Lorsque nous synthétisons la revue de littérature effectuée sur le lien entre les systèmes interorganisationnels et les relations interentreprises, nous arrivons aux quatre conclusions suivantes.

Premièrement, certaines dimensions des relations interentreprises possèdent un lien très clair avec l'utilisation des systèmes interorganisationnels. Ces systèmes améliorent la quantité, fréquence et qualité de l'information qui est échangée entre les partenaires d'affaires. En effet, aucune étude ne semble aller dans le sens inverse. Il en va de même pour la dimension de l'adaptation. Toutes les études sont de concert pour affirmer qu'un certain niveau d'adaptation est nécessaire pour utiliser les systèmes interorganisationnels.

Deuxièmement, les systèmes interorganisationnels peuvent avoir un effet contradictoire sur les relations interentreprises. Les effets dépendront de la dimension des relations interentreprises observée. Par exemple, la dimension communication et partage de l'information est définitivement positivement corrélée à l'utilisation des systèmes interorganisationnels (Ramaseshan, 1997; Manthou et Vlachopoulou, 2001; Carr et Smeltzer, 2002) ce qui contribue à améliorer les relations interentreprises. Cependant, la dimension conflit semble également être positivement corrélée à l'utilisation des systèmes interorganisationnels (Webster, 1995; Gulledge, 2002; Wilson et Vlosky, 1998) ce qui contribue inversement à diminuer les relations interentreprises.

Troisièmement, parfois la même dimension des relations interentreprises sera affectée de différentes manières dépendant du type de système interorganisationnel utilisé. À titre d'exemple, l'engagement entre les partenaires d'affaires semble être plus élevé lorsqu'ils utilisent un système de type Extranet (Vlosky et al. 2000) et plus bas lorsqu'on introduit une place d'affaire électronique (White et Daniel, 2004). Ainsi nous voyons que la nature du système interorganisationnel influencera les relations interentreprises de manières différentes. Il sera donc essentiel de considérer cet aspect dans notre étude en prenant bien soin de clairement identifier le type de système interorganisationnel étudié.

Quatrièmement, non seulement les systèmes interorganisationnels peuvent influencer les différentes dimensions des relations interentreprises mais il semblerait que cette influence peut également avoir lieu à contresens. Les relations interentreprises peuvent affecter l'adoption et l'utilisation des systèmes interorganisationnels. À ce sujet, la dimension du déséquilibre du pouvoir et de l'interdépendance est reconnue pour affecter l'adoption des systèmes EDI (Webster, 1995; Iacovou et al. 1995; Wilson et Vlosky, 1998; Chwelos et al. 2001), l'utilisation de systèmes EDI (Ramaseshan, 1997) et l'adoption des systèmes de codes à barres (Wilson et Vlosky, 1998).

À la lumière de toutes ces informations, nous pouvons maintenant développer le cadre conceptuel qui guidera l'étude et envisager une démarche méthodologique appropriée (chapitre 3).

CHAPITRE 3. CADRE CONCEPTUEL PROPOSÉ ET DÉMARCHE PRIVILÉGIÉE

Suite à notre revue de littérature, nous sommes maintenant en mesure d'élaborer un cadre conceptuel qui pourrait expliquer la dynamique du phénomène d'adoption des systèmes interorganisationnels dans la chaîne d'approvisionnement.

3.1. Le cadre conceptuel proposé

La figure 3.1 représente ce cadre conceptuel qui incorpore les principales dimensions relevées dans notre revue de littérature et les propositions de recherche qui en découlent.

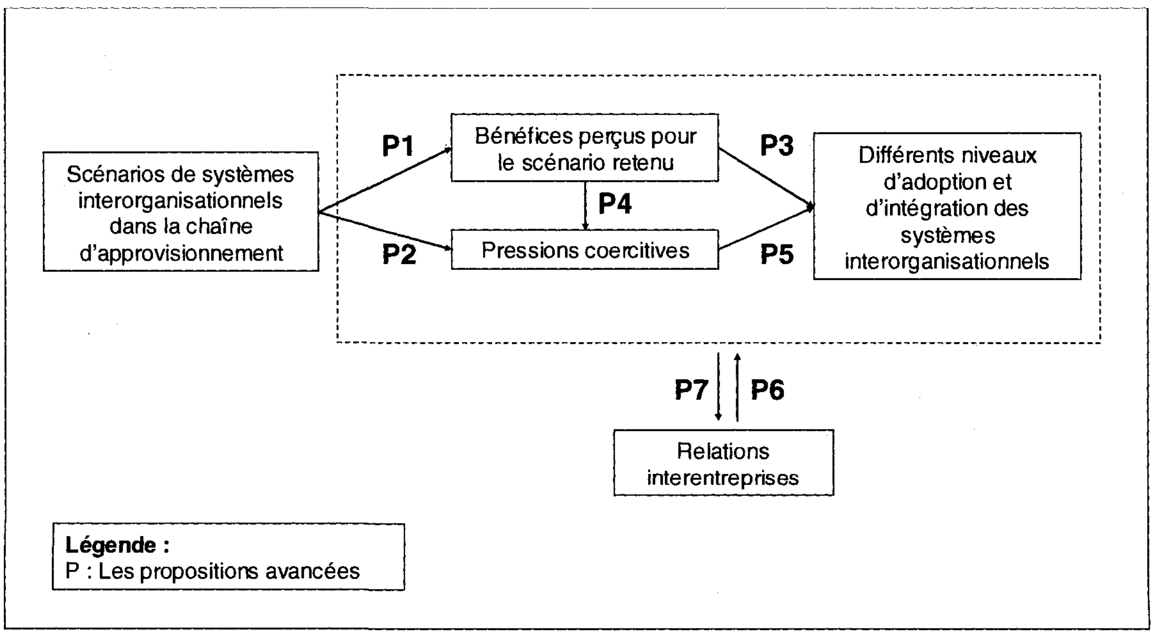

Figure 3.1 : Cadre conceptuel proposé

3.1.1. Scénarios de systèmes interorganisationnels dans la chaîne d'approvisionnement

Un objectif d'affaires peut être atteint grâce à différentes technologies. Par exemple, l'échange d'informations entre entreprises peut être accompli grâce à la technologie EDI, une place d'affaires électroniques ou la technologie RFID. Il va de soi que ces différentes technologies ont chacune leurs particularités, leurs fonctionnalités qui leur sont propres et différentes manières de les utiliser. Ainsi, dans le cas de la technologie EDI, l'entreprise devra décider si la communication passera par un réseau à valeur ajoutée ou par Internet. Elle devra également décider si les communications seront générées automatiquement par son système ou non. Dans le cas d'une place d'affaires électroniques, l'entreprise choisira d'utiliser un système privé, public ou celui provenant d'une tierce partie. Le choix du type de places d'affaires électroniques déterminera également la nature des échanges qui seront soit transactionnels ou collaboratifs. En terme de technologie RFID, l'entreprise déterminera si les balises seront apposées sur les items, les caisses ou les palettes. De plus, elle devra déterminer si elle utilise une codification standardisée ou déterminée par elle-même puis, si l'information est échangée avec ses partenaires en transitant via un réseau privé ou par le réseau du Electronic Product Code (EPC). Tous ces choix, qui ne représentent pas une liste exhaustive, démontrent à quel point les systèmes interorganisationnels utilisés dans la chaîne d'approvisionnement peuvent suivre différents types de scénarios d'utilisation.

Bien évidemment, ces différents scénarios d'utilisation apporteront chacun leur structure de coûts et de bénéfices pour l'entreprise qui les utilise. En fonction de la réalité d'affaires et de la réalité technologique de l'entreprise instigatrice, certains scénarios seront impossibles, d'autres irréalistes et puis certains, profitables. Nous en arrivons donc à notre première proposition de recherche :

P1 : Les différents scénarios de systèmes interorganisationnels dans la chaîne d'approvisionnement influencent les bénéfices perçus.

Nous pouvons également supposer à ce stade qu'en fonction de l'écart technologique présent entre l'entreprise instigatrice et l'entreprise incitée, son emplacement dans le réseau social, ainsi que des objectifs d'affaires possiblement divergents, l'entreprise incitée peut percevoir ou non une pression à adopter le scénario proposé. Nous proposons donc que :

P2 : Les scénarios de systèmes interorganisationnels dans la chaîne d'approvisionnement peuvent entraîner la création de pressions coercitives.

3.1.2. Différents niveaux d'adoption et d'intégration des systèmes interorganisationnels

L'intégration de ces technologies peut également se faire à différents niveaux. Dans le cas des transactions reliées au processus de commandes par exemple, une entreprise peut acquiescer aux demandes d'utilisation de systèmes d'approvisionnement soit en recevant des télécopies ou des courriels dont le contenu sera retranscrit dans son système interne dans le cas d'un système non-intégré, soit en utilisant une interface Web sur Internet dans le cas d'un système semi-intégré, ou en effectuant un échange directement de système à système dans un cas complètement intégré.

3.1.3. Bénéfices perçus pour le scénario retenu

La dimension bénéfices perçus est celle qui influence le plus l'adoption lors d'une prise de décision intrinsèque telle que celle effectuée par l'entreprise instigatrice. Plus les bénéfices perçus seront importants et plus l'entreprise instigatrice aura tendance à adopter le scénario proposé.

P3 : Plus les bénéfices perçus pour le scénario retenu sont élevés et plus le niveau d'adoption et d'intégration des systèmes interorganisationnels le sera également.

Or, puisque son adoption dépend également de l'adoption par ses partenaires, nous postulerons que plus l'attrait pour ce scénario sera élevé et plus l'entreprise instigatrice aura tendance à l'imposer à l'entreprise incitée :

P4 : Plus les bénéfices perçus pour le scénario retenu seront élevés pour l'entreprise instigatrice, plus l'entreprise incitée subira des pressions coercitives.

3.1.4. Pressions coercitives

Les pressions coercitives relèvent des éléments externes à l'entreprise qui proviennent des partenaires commerciaux pour expliquer l'adoption que l'entreprise incitée pourrait faire des systèmes interorganisationnels. Lorsqu'une entreprise instigatrice demande à l'entreprise incitée d'adopter un système de scénarios interorganisationnels dans la chaîne d'approvisionnement, l'entreprise incitée devient la cible des pressions coercitives.

P5 : Les pressions coercitives de la part de l'entreprise instigatrice résulteront en l'adoption et l'intégration par l'entreprise incitée des systèmes interorganisationnels selon différents niveaux.

3.1.5. Relation interentreprises

Les relations interentreprises agissent comme variable modératrice sur l'ensemble du système que nous venons de décrire. Le pouvoir de l'entreprise instigatrice pourra influer sur les différentes propositions que nous avons présentées. Il en va de même pour les autres dimensions du concept des relations interentreprises.

P6 : Les relations interentreprises modéreront les propositions P1, P2, P3, P4, P5.

De plus, la dynamique entourant la démarche effectuée par l'entreprise instigatrice envers l'entreprise incitée entraînera une rétroaction qui pourra être perçue en observant les relations interentreprises.

P7: Les pressions coercitives exercées dans le but d'adopter et d'intégrer des systèmes interorganisationnels aura un impact sur les relations interentreprises.

La prochaine section (3.2) vise à expliquer la démarche empruntée pour évaluer ces propositions.

3.2. Démarche privilégiée

Rappelons que la problématique générale qui guide notre recherche est de « comprendre le processus d'adoption de systèmes d'information interorganisationnels dans un contexte de chaîne d'approvisionnement, et plus spécifiquement l'importance relative des bénéfices perçus, l'influence des pressions coercitives et le rôle des relations interentreprises ». Puisque cette problématique est assez large et que peu d'études académiques se sont concentrées sur le sujet, nous avons effectué plusieurs études avec des approches méthodologiques assez variées, autant qualitatives que quantitatives, afin de parvenir à y répondre. Ainsi, la démarche générale de notre recherche dans le cadre de la thèse s'inscrit dans un programme de recherche plus large qui a duré plus de cinq années. Le tableau 3.1 présente le programme de recherche articulé selon quatre projets et les approches méthodologiques privilégiées ainsi que mon implication personnelle à titre de chercheur au centre ePoly.

Tableau 3.1 : Programme de recherche, projets et démarches méthodologiques privilégiées

Projets	Systèmes interorganisationnels	Approches méthodologiques privilégiées	Implication personnelle
Projet portant sur l'adoption du commerce électronique interentreprises par les PME	Applications de commerce électronique interentreprises	1. **Étude pilote** pour identifier et valider les variables de recherche 1.1 : simulations d'applications de commerce électronique au centre ePoly 1.2 : cinq groupes de discussions avec des PDG d'entreprises manufacturières 1.3 : approche Delphi avec douze experts indépendants 2. **Enquête par questionnaire électronique**; nombre de répondants 192 PME manufacturières. 3. **Études de cas détaillées** dans 12 PME; multiples sources d'information: des informations publiques, des rapports internes et des entrevues semi-structurée avec des 26 cadres supérieurs	Rôle limité après que la cueillette des données ait été terminée. Participation à l'analyse des résultats pour un article et à la rédaction de cet article.

Tableau 3.1 : Programme de recherche, projets et démarches méthodologiques privilégiées (suite)

Projets	Systèmes interorganisationnels	Approches méthodologiques privilégiées	Implication personnelle
Projet portant sur l'adoption de pratiques d'affaires électroniques par des fournisseurs de clients influents	Applications de commerce électronique interentreprises	**Étude sur le terrain dans une chaîne d'approvisionnement dans l'industrie des métaux primaires.** **Études de cas** : deux donneurs d'ordres influents, huit fournisseurs et quatre places d'affaires électroniques. **Multiples sources** : analyse des tendances lourdes de ce secteur, simulations des places d'affaires électroniques, rapports internes, données corporatives publiques entrevues semi-structurées avec 28 cadres et employés.	Participation active à toutes les étapes de la collecte de données qui a duré 8 mois, à l'analyse des données et à la rédaction d'articles.

Tableau 3.1 : Programme de recherche, projets et démarches méthodologiques privilégiées (suite)

Projet portant sur l'impact de la technologie RFID sur une chaîne d'approvisionnement dans l'industrie du détail	RFID	**Étude sur le terrain dans une chaîne d'approvisionnement dans l'industrie du commerce de détail (alimentation)** **Études de cas** : trois embouteilleurs, un distributeur de premier niveau, trois distributeurs de deuxième niveau et trois détaillants. Cette chaîne d'approvisionnement fournit annuellement environ 180 millions d'unités sur le marché. **Source d'information multiples** : analyse des tendances lourdes de ce secteur, simulations des processus d'affaires, rapports internes, données corporatives publiques, entrevues semi-dirigées avec 52 répondants (cadres et employés); observations sur place, cartographie détaillée du processus de réception en entrepôt, études de temps et mouvements pour ce processus (941 mesures valides et 44 mesures de	Participation active à la collecte de données qui s'est échelonnée sur une période de 3 ans. Participation active à l'élaboration, la simulation et la validation des scénarios intégrant la technologie RFID. Participation active à la rédaction d'articles.

Tableau 3.1 : Programme de recherche, projets et démarches méthodologiques privilégiées (suite)

		vérification) **Élaboration et simulation de scénarios intégrant la technologie RFID** : Validation des scénarios avec des groupes de discussion composés de cadres supérieurs détenant les pouvoirs décisionnels.	
Projet portant sur l'impact de la technologie RFID sur une chaîne d'approvisionnement dans l'industrie de la distribution de l'électricité	RFID	**Étude sur le terrain dans une chaîne d'approvisionnement dans l'industrie de la distribution de l'électricité** **Études de cas :** un manufacturier et le centre d'entreposage et de distribution du client (qui fournit 90 magasins industriels et des centaines de techniciens installateurs), un magasin industriel et l'installateur. **Source d'information multiples** : entrevues semi-dirigées avec 27 répondants (cadres et employés);	Participation active à la collecte de données qui s'est échelonnée sur une période de plus de 2 ans. Participation active à l'élaboration, la simulation et la validation des scénarios intégrant la technologie RFID. Participation active à la rédaction

Tableau 3.1 : Programme de recherche, projets et démarches méthodologiques privilégiées (suite et fin)

		observations sur place, cartographie détaillée de tous les processus dans le centre de distribution et chez le fournisseur. **Élaboration et simulation de scénarios intégrant la technologie RFID** : Validation des scénarios avec des intervenants clefs dans le projet RFID des entreprises impliquées.	d'articles

À partir du tableau 3.1, nous pouvons faire les commentaires suivants :

1) Les quatre projets de recherche ont nécessité des efforts de recherche considérables et ont donc exigé la participation de plusieurs chercheurs. Mon niveau d'implication varie de projet en projet. Ainsi, le premier projet a surtout servi d'apprentissage personnel et a permis de bâtir les assises nécessaires pour comprendre la dynamique d'adoption des applications de commerce électronique interentreprises. En particulier, les niveaux d'adoption et d'intégration proposés suite aux résultats de ce projet représentent des intrants directs à ma problématique de recherche. De plus, ce projet m'a permis de me familiariser avec des analyses statistiques. Ce premier projet représente une implication minimale de ma part. Pour les trois autres projets, mon implication est nettement plus significative et est centrée sur les relations interentreprises.

2) La stratégie méthodologique commune à ces quatre projets correspond à une recherche exploratoire ancrée dans la réalité des entreprises (grounded theory) (Glaser et Strauss, 1967; Glaser, 1992). De plus, elle s'apparente fortement à la recherche-action (Miles et Huberman, 1994) puisque des simulations furent conduites ou des scénarios furent élaborés et validés (preuves de concept) dans un contexte de laboratoire universitaire.

3) La démarche privilégiée s'aligne avec le management de la technologie, puisque les méthodes de recherche comme les études de cas se retrouvent souvent dans le domaine de la gestion et que la simulation de scénarios technologiques exige une connaissance approfondie des technologies. À titre d'exemple, un des scénarios technologiques qui intègre la technologie RFID a résulté dans une preuve de concept sous forme de simulation en temps réel dans le centre ePoly. Le système utilisait des puces passives « Alien M tags »

de deuxième génération opérant à 915 MHz comportant des doubles antennes bipolaires et des lecteurs à ultra haute fréquence de différentes configurations. Un lecteur portatif « Symbol MC9060R », un lecteur mobile « Symbol RD5000 » et un lecteur fixe « Symbol XR400 » connecté à des antennes à haute performance bistatique « Symbol AN400 ». L'infrastructure était gérée par un automate programmable industriel et connectée à deux intergiciels ou middleware (Catamaran et Ship2Save). Le tout était intégré aux différents modules de SAP (MM, SD, FI/CO).

4) Les méthodes de collecte de données pour un même projet sont multiples permettant ainsi la triangulation des données (Yin, 2003; Miles et Huberman, 1994). Ces méthodes génèrent une synergie entre données qualitatives (dans le cas par exemple des entrevues semi-structurées) et données quantitatives (dans le cas par exemple de l'étude temps et mouvements), ce qui engendre une analyse plus riche selon plusieurs auteurs (Tashakkori et al, 1998; Creswell, 1994).

5) Les quatre projets sont menés dans des secteurs industriels différents, et dans des entreprises de tailles différentes, ce qui permet une validité externe plus élevée que si l'on s'était concentré dans un seul secteur.

Notons que les aspects méthodologiques sont présentés de façon plus détaillée dans chacun des articles de la thèse.

3.3 Articles de thèse, liens avec le programme de recherche et objectifs spécifiques

Le tableau 3.1 donne quelques indications sur les quatre projets du programme de recherche. Nous allons maintenant en faire une brève description.

3.3.1. Projet portant sur l'adoption du commerce électronique interentreprises par les PME manufacturières

Ce projet visait à évaluer l'utilisation du commerce électronique par les PMEs manufacturières canadiennes.et leurs intentions à court terme d'adopter des applications de commerce électronique additionnelles. Un des résultats de ce projet fut de proposer la notion de trajectoires d'adoption, c'est-à-dire d'analyser comment les PME passent d'un stade élémentaire de commerce électronique (processus électroniques transactionnels) à un stade plus avancé, le stade le plus sophistiqué étant la collaboration électronique qui inclut des processus tels que l'optimisation de la logistique inversée, l'ingénierie collaborative en ligne avec les clients ou l'intégration des logiciels qui supportent la conception assistée par ordinateur.

Un des extrants de ce projet prend la forme de l'article présenté à l'annexe A (Lefebvre et al. 2005b). Notons que cet article, qui a obtenu le classement honorifique de « TOP25 Hottest Articles - downloaded during January, February and March, 2006 - within the journal Technovation », a permis d'établir les bases théoriques pour les prochaines étapes de la recherche.

3.3.2. Projet sur l'adoption de pratiques d'affaires électroniques par des fournisseurs de clients influents

Le deuxième projet consistait à dégager les dynamiques organisationnelles et interorganisationnelles lors de l'adoption de pratiques d'affaires électroniques dans l'industrie des métaux primaires. Ce projet a permis d'explorer le concept de l'adoption forcée et d'observer l'influence des pressions coercitives dans les stades d'adoption du commerce électronique. Trois publications où j'ai agi comme co-auteur ont découlé de ce projet. La première publication a pris la forme d'un article de conférence (Boeck et al. 2004) où nous avons présenté la matrice d'analyse développée durant l'étude qui nous a permis de mieux comprendre les exigences des grands donneurs d'ordres. La deuxième publication présente les résultats préliminaires de l'étude lors d'une conférence académique (Boeck et al. 2006) tandis que la dernière présente l'ensemble des résultats de l'étude Boeck et al. (2008).

3.3.3. Projet portant sur l'impact de la technologie RFID sur une chaîne d'approvisionnement dans l'industrie du détail

Si les deux premiers projets ont traité des applications de commerce électronique interentreprises, les deux prochains projets examinent l'impact de la technologie RFID. Le troisième projet constitue un effort de recherche majeur qui a résulté en plusieurs publications, dont sept où j'ai agit comme co-auteur. La première a été présentée lors d'une conférence académique et compare les processus d'affaires actuelles à ceux qui existeraient suite à l'implantation de la technologie RFID pour améliorer le processus de réception d'un entrepôt (Lefebvre et al. , 2005a). Cet article a par la suite été amélioré et publié dans un recueil des meilleurs articles présentés à la conférence (Lefebvre et al. 2007). Il est présenté dans l'annexe B de cet ouvrage. La troisième publication a été présentée lors d'une autre conférence académique et présente la méthodologie utilisée pour évaluer l'impact de la technologie RFID dans une chaîne d'approvisionnement (Lefebvre et al. 2006). Une version améliorée de cet article a par la suite été publiée dans une revue académique (Lefebvre et al. 2006). L'étude étant très riche en résultats, nous avons pu publier un autre article sur les flux de l'information dans la chaîne d'approvisionnement avec la technologie RFID en incorporant une partie de l'analyse des temps et mouvement (Fosso Wamba et Boeck, 2008). Un autre article traite de l'influence de la technologie RFID sur les relations interentreprises dans une chaîne d'approvisionnement complète (Boeck et Fosso Wamba, 2008). Finalement, un dernier issu de l'étude présente différents scénarios technologiques lors du processus de réception (Boeck et al. 2008). Ces deux derniers articles se retrouvent respectivement en chapitre 5 et 6 de cette thèse.

3.3.4. Projet portant sur l'impact de la technologie RFID sur une chaîne d'approvisionnement dans l'industrie de la distribution de l'électricité

Ce quatrième projet a également tenté d'évaluer l'impact de la technologie RFID sur quatre niveaux d'une chaîne d'approvisionnement dans le secteur spécifique de la distribution électrique. Cette initiative a surtout servi à valider les observations de l'étude précédente et à identifier des indicateurs de performance au niveau des entreprises individuelles et au niveau de la chaîne d'approvisionnement. Certaines des données issues de ce projet ont servies à la rédaction de l'article qui est présenté dans le chapitre 6.

La figure suivante illustre les liens entre ces quatre projets et les articles présentés dans cette thèse.

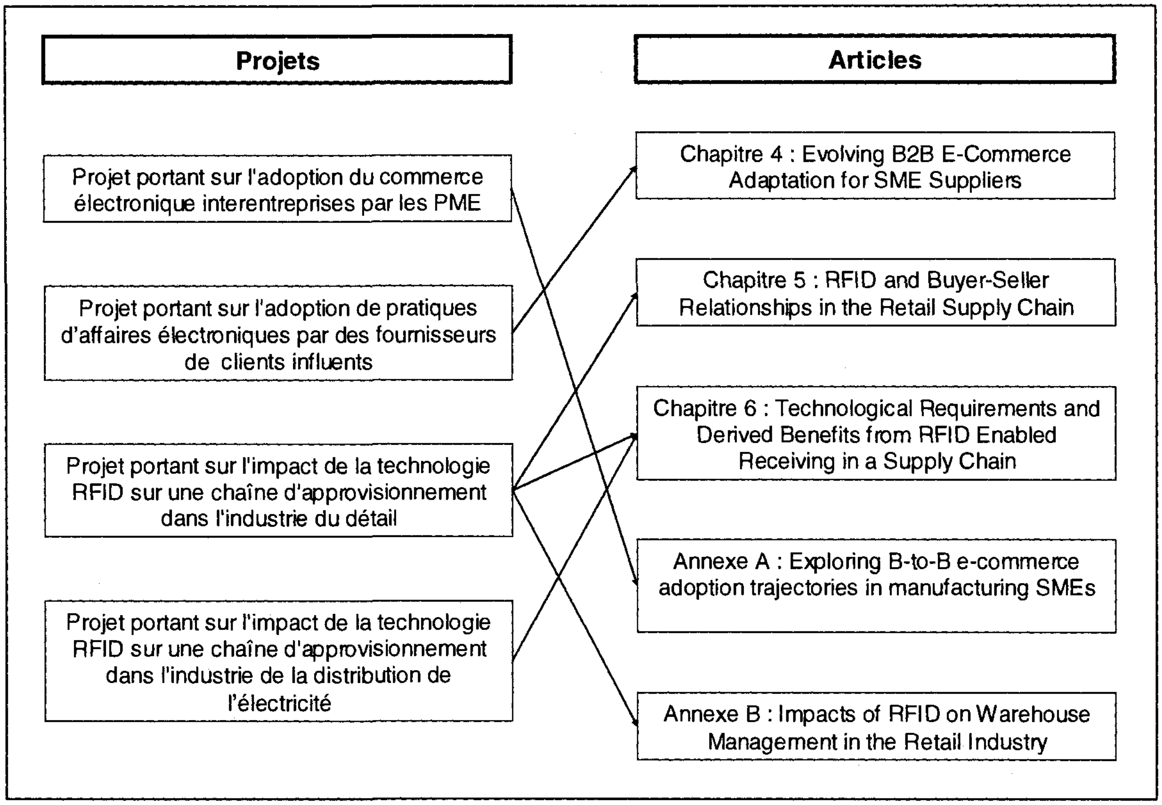

Figure 3.2 : Articles présentés dans la thèse et liens avec le programme de recherche

3.3.5. Premier article

Le premier article intitulé « Evolving e-Commerce Pressures on SME Suppliers » est issu du travail effectué lors du deuxième projet et traite de l'adoption imposée par des clients influents. Dans cet article, nous tentons d'examiner les relations multiples entre l'élaboration des scénarios de systèmes interorganisationnels dans la chaîne d'approvisionnement, les bénéfices perçus et la présence de pressions coercitives. Ce premier article a été soumis à la revue « Journal of Business and Industrial Marketing » le 22 août 2007. Les premiers commentaires des évaluateurs ont été reçus le 16 janvier 2008. Une version modifiée a été soumise 31 janvier 2008 et la principale modification consistait à trancher 1542 mots de l'article original. La version finale a été acceptée le 28 mai 2008. La version de l'article telle que soumise initialement est présentée dans le chapitre 4 de la thèse.

3.3.6. Deuxième article

Le deuxième article intitulé « RFID and Buyer-Seller Relationships in the Retail Supply Chain » provient du troisième projet (figure 3.2). L'article a comme un des objectifs spécifiques d'évaluer l'influence des relations interentreprises sur l'adoption et l'utilisation des systèmes interorganisationnels. De plus, l'article démontre également les liens qui existent entre les bénéfices perçus pour le scénario retenu et les pressions coercitives exercées.

Cet article a été soumis à la revue « International Journal of Retail & Distribution Management » le 16 juillet 2007. Des modifications mineures ont été demandées le 6 septembre 2007 puis son acceptation a été obtenue le 23 octobre de la même année. L'article a été publié dans le volume 36, numéro 6 de la revue. L'article est présenté dans le chapitre 5 sous la forme initiale lors de la soumission.

3.3.7. Troisième article

Le troisième article tente de tisser les liens entre les scénarios de systèmes interorganisationnels dans la chaîne d'approvisionnement et les bénéfices perçus pour le scénario retenu. Tel qu'indiqué à la figure 3.2, les résultats proviennent des troisième et quatrième projets. L'article est intitulé « Technological Requirements and Derived Benefits from RFID Enabled Receiving in a Supply Chain ». Il a été soumis le 16 mai 2007, accepté avec des modifications mineures et publié aux Etats-Unis dans le livre « RFID Handbook: Applications, Technology, Security and Privacy » en mars 2008. L'article est présenté dans le chapitre 6 de la thèse tel qu'il a été soumis initialement.

3.3.8. Articles présentés en annexe

Deux articles additionnels sont présentés en annexe de cette thèse car ils font partie des études qui ont permis de répondre à la problématique générale sans que je ne sois l'auteur principal.

Le premier article présenté en annexe A est intitulé « Exploring B-to-B e-commerce adoption trajectories in manufacturing SMEs » et a été publié dans la revue « The International Journal of Technological Innovation, Entrepreneurship and Technology Management » (Lefebvre et al. 2005b). Il démontre bien le lien qui existe entre les bénéfices perçus pour le scénario retenu et les différents niveaux d'adoption et d'intégration des systèmes interorganisationnels. De plus, il a fourni le cadre pour conduire les entrevues semi-structurées et élaborer les outils de collecte de données qui ont servi pour le premier article.

Le deuxième article présenté en annexe B est intitulé « Impacts of RFID on Warehouse Management in the Retail Industry » (Lefebvre et al. 2007) et a été publié dans le livre « Challenges in the Management of New Technologies » publié par la maison d'édition World Scientific Publishing. Cet article a servi de base pour créer les premiers liens entre les scénarios de systèmes interorganisationnels dans la chaîne d'approvisionnement et les bénéfices perçus pour le scénario retenu avec la technologie RFID. Cet article est donc complémentaire à celui présenté dans le chapitre 6.

Les trois prochains chapitres présentent respectivement les trois articles de thèse.

CHAPITRE 4. EVOLVING B2B E-COMMERCE ADAPTATION FOR SME SUPPLIERS

Abstract

Purpose - The paper explores a central issue in industrial marketing, namely the buyer-seller relationship, by focusing on how its development influences and is influenced by the use of B2B e-commerce strategies. More specifically, the paper aims at (1) identifying what kinds of B2B electronic interactions are imposed by influential buyers, (2) exploring the link between these electronic interactions and the buyer-seller relationship, and (3) seeing how influential buyers and SME suppliers adapt their own strategies in this online environment.

Methodology/Approach - The multi-case study methodology was used to allow for rich data collection and analysis and to support the discovery of patterns.

Findings - The results indicate that large buyers use specific e-commerce processes and tools for the different relationships they have with their SME suppliers. The latter must adapt to these requirements to attain the next relationship level or risk forfeiting their established position. When a supplier reaches the new level, other requirements arise, forcing it to continuously adapt its e-commerce strategy.

Research limitations/implications - The model proposed in this paper can serve as a tool to align B2B e-commerce strategies and buyer-seller relationship levels.

Practical implications - Some SME suppliers have developed a competitive advantage by going through this cycle faster than their competitors. The following relationship stages were observed: pre-relationship, spot relationship and contractual relationship. Interestingly, there was no collaboration stage in the relationships studied.

Originality/value of paper - The paper contributes to our understanding of the link between electronic interactions and the buyer-seller relationship by exploring the electronic interactions that influential buyers will oblige their SME suppliers to engage in and by explaining how these requirements evolve over time according to the level of the relationships. Its information is particularly relevant to organizations that transact or plan on transacting electronically with clients or suppliers in a B2B setting.

Keywords: Buyer-seller relationship, SME, e-commerce adoption, dyadic adaptation, supply chain management

4.1. Introduction

Electronically mediated interactions between business partners are increasingly replacing the more traditional methods of conducting business. This change in the way business is done is even more palpable in industries that are dominated by large, influential buyers, where the use of electronic exchange platforms to conduct Business-to-Business (B2B) electronic commerce (e-commerce) is considered to be a powerful, even inescapable, requirement. It is within this context that this article explores a central issue in industrial marketing, namely the buyer-seller relationship, by focusing on how its development influences and is influenced by the use of B2B e-commerce strategies. More specifically, the research objectives of this article are to (1) identify what kinds of B2B interactions are imposed by influential buyers who want to do business electronically with their suppliers, (2) explore the link between these electronic interactions and the buyer-seller relationship, and (3) see how influential buyers and SME (Small and Medium-sized Enterprise) suppliers adapt their own strategies in this online environment.

This line of inquiry seems particularly relevant because current knowledge of the role of the buyer-seller relationship as a determinant of e-commerce adoption behavior among SMEs remains scarce. Smaller suppliers are dependent on large buyers' processes (Quayle, 2003). They are also naturally inclined to adapt to their trading partners' initiatives (Brennan et al. 2003). Although they are making great strides in adopting e-commerce by placing it at the center of their technological and corporate business plans (Drew, 2003; Damaskopoulos and Evgeniou, 2003), their progress in this regard still remains limited compared to that of their larger business partners (Elia et al. 2003; Lucchetti and Sterlacchini, 2004; Quayle, 2003; Archer et al. 2003; Wagner et al. 2003). This mismatch in the B2B e-commerce adoption rate between larger and smaller trading partners creates tensions since the larger partners, in order to integrate their supply chains, will tend to exert pressure on SMEs to conduct more electronic interactions. Past research has demonstrated that SMEs are more vulnerable to outside e-commerce initiatives. Indeed, it has long been recognized that large buyers have the power to influence their suppliers to adopt Inter-Organizational Systems (IOS) (Chwelos et al. 2001; Iskandar et al. 2001a; Kurokawa and Manabe, 2002), regardless of whether that power is seen as coercive ("by means of threats") or non-coercive ("by means of promises") (Boyle and Dwyer, 1995). Furthermore, several studies have demonstrated that external factors explain most e-commerce adoption by SMEs (Damaskopoulos and Evgeniou, 2003; Grandon and Pearson, 2004), and that their e-commerce initiatives tend to focus on specific trading partners (Chan and Swatman, 2004).

Our current knowledge of this phenomenon leaves several questions unanswered. First, since the relationship with their larger trading partners is so important, why do SME suppliers seem to be adapting to B2B e-commerce so slowly and unresponsively? Second, can the pressures exerted by the influential buyer be strong enough to eventually destroy the relationship with the supplier and make previous relationship investments worthless? Third, in an effort to improve the efficiency of the interactions between buyer and seller, can power be used to induce electronic collaboration? Fourth, when dealing with large clients' requirements, SME suppliers often have limited choices. Their dilemma is as follows: adapting to those requirements means incurring additional costs whereas refusing to adapt could result in a loss of revenues. How can the SME suppliers best handle this situation in order to remain competitive? This last question is of particular interest to practitioners.

The article is structured as follows. The next section, the research background, provides an overview of the available knowledge and theoretical issues related to the line of inquiry. The methodology section outlines the approach that was used in the field study, then the main research findings are presented. In the last section, we discuss how our findings contribute to answering the above questions and draw some conclusions regarding the paper's contributions and suggestions for further research.

4.2. Research Background

This paper builds on three distinct areas of knowledge: the literature on buyer-seller relationships, on the adoption and use of IOS technology, and on portfolio models.

When examining buyer-seller relationship, the notion of evolution is important. Relationships are not stable, but constantly evolving. Various classifications of the development of the buyer-supplier relationship have been proposed and used in the academic literature: from transactional to relational (Archer and

Yuan, 2000; Grönroos, 1994), opportunistic to collaborative (Cousins and Spekman, 2000), arm's-length to partnership (Sako, 1992; Dyer, 2000), exit to voice (Mudambi and Helper, 1998), partner selection to relationship maintenance (Wilson, 1995), searching process to termination process (Batonda and Perry, 2003), etc. While the names differ, their central premise is identical: relationships evolve. Also of importance in the previous work on buyer-seller relationships is the concept of dyadic adaptation, defined "as the behavioral or organizational modifications at the individual, group or corporate level, carried out by one organization, which are designed to meet the specific needs of one other organization" (Brennan et al. 2003). This concept is often associated with the level of influence that one partner exerts on another (Brennan and Turnbull, 1999). Dyadic adaptation is more frequent on the supplier side (Brennan et al. 2003), which may be partly attributable to the natural tendency of a supplier to adapt to its buyer's requirements.

Research on adoption of various types of IOSs such as Electronic Document Interchange (EDI) or e-marketplaces that are used to conduct B2B transactions has become a central point of interest in the academic literature (Chang et al. 2003; Markus and Christiaanse, 2003). Several studies indicate that a single type of IOS cannot fit all business situations. For example, certain e-marketplaces are more appropriate to specific types of buyer-supplier relationships (Skjott-Larsen et al. 2003). Moreover, the use of different IOSs influences buyer-supplier relationships (Carr and Smeltzer, 2002). It is therefore desirable to manage the fit between the buyer's purchasing situation and the IOS to optimize value creation in the buyer-supplier relationship (Hartmann et al. 2002). Other authors take into account the goal pursued by business partners, which is an important dimension of the relationship (Mudambi and Helper, 1998),(Mohr and Spekman, 1994) in explaining the adoption of transactional or cooperative IOSs, suggesting that each has different benefits and adoption considerations (Markus and Christiaanse, 2003). Overall, previous research highlights the relevance of using the buyer-seller relationship perspective in order to understand the adoption and use of the IOSs examined in our study.

The literature on purchasing and relationship portfolio models provides some useful tools for understanding how buyers manage different supplier relationships. Since the 1980s, the concept of portfolio management in buyer-seller relationships (Kraljic, 1983; Fiocca, 1982; Shapiro et al. 1987) has been used to understand business markets or categorize customers and suppliers and support strategy orientations (Krapfel et al. 1991; Olsen and Ellram, 1997; Dabholkar and Neeley, 1998; Bensaou, 1999). For example, Bensaou (1999) suggests a classification of buyer-seller relationships based on their specific investments. This implies that investments in proprietary IOSs can influence the buyer-seller relationship. Other authors propose various models to provide input into management decisions by suggesting portfolios characterized by "buyer-supplier power-dependence" (Gelderman and Van Weele, 2000) or transaction cost (Krapfel et al. 1991). Finally, an interesting perspective suggests looking at the "goal of the relationship" and "the balance of power" from a "temporal perspective" (Dabholkar and Neeley, 1998). The buyer can view the relationship from a short-term perspective focused on a single or a few limited transactions, or from a long-term perspective focused on repeated transactions. The concept of portfolios has also been applied to the e-commerce context. For example, the Kraljic purchasing portfolio model has been taken as a starting point to determine the type of IOS best suited for the purchase of various types of products (Santema, 2003). The same exercise has also been performed to build a taxonomy of e-marketplaces (Sawhney and Kaplan, 2000). Although portfolio models present some limitations in relationship analysis (Dubois and Pedersen, 2002; Leek et al. 2002) because the variables they include are often subjective and difficult to measure, these models present dimensions that are essential in interpreting the data gathered from the field and help to explain why different relationships use different IOSs.

4.3. Methodology

The previous section presented the academic research that was consulted in order to understand the context of the study and interpret the data as it was being gathered. It represents the initial literature review. Once the results from the study were completed, additional literature was reviewed to theoretically validate the findings and compare them with existing research. This additional literature review is integrated into the research findings and discussion sections. This approach is appropriate and even recommended for qualitative research models (Creswell, 2003). The setting, the primary metal industry, provided ample data because recent developments have been transforming the industry and the way in which interactions are conducted. Our initial observations confirmed that influential buyers were exercising pressure on their SME suppliers to adopt B2B e-commerce. Very few academic studies have been performed in this industry, making it interesting and original.

4.3.1. Data collection and analysis

The study was strongly grounded in empirical data, mostly gathered during on-site factory visits and multiple executive interviews. The face-to-face interviews were very helpful for collecting historical information from the participants (Creswell, 2003). Consequently, the researchers were able to observe first-hand the buyer-seller relationships as they were being redefined. Other sources of information were also used to allow triangulation: telephone interviews to validate data with other key employees, internal reports, publicly available corporate documents, Internet-based information on the firms and an extensive review of industry reports and technological trends.

There was an emphasis on electronic business processes as a way of analyzing electronic interactions. Using business processes in the context of studying buyer-seller relationships seems appropriate since processes help to understand "the dynamic aspects of the exchange: actions and behavior within the relationship" (Izquierdo and Cillán, 2004) and therefore provide detailed insights into the interactions between buyer and seller. This approach has already been used to provide an interesting analysis of buyer-seller relationships (Cannon and Perreault, 1999).

The research was not conducted in a linear manner. Many iterations were necessary as the researchers would return on site for clarification and additional discovery until saturation was reached (Glaser and Strauss, 1967). The entire process lasted 8 months. Other steps taken to ensure internal validity included peer debriefing (Creswell, 2003), grounding the research question in a contemporary real-life context, and having information and findings validated by the participants. In order to achieve greater reliability, three researchers collected data simultaneously. When discrepancies or different interpretations were found, discussions ensued. If discussions were not necessary to reach consensus, the data was triangulated or the researchers were asked to revalidate the data with the respondents. This process allows for rich interpretations. An attempt at analytical generalization (Yin, 2003) was made by applying the results from Buyer 1 to a completely separate organization, namely Buyer 2.

4.3.2. The field research

The field research was conducted in the primary metal industry, in which very few academic studies have been performed. The multi-case study methodology was retained in order to understand and explain "how" and "why" B2B interactions were evolving in the industry and explore the link between electronic interactions and buyer-seller relationships. This methodology is justified when the research is exploratory in nature (Yin, 2003), as it has already been used to develop theory in an e-commerce context (Daniel and Wilson, 2003) and follows an academically validated process (Eisenhardt, 1989). The field study is based on empirical evidence from the two largest primary metal-producing companies in their metal category (Buyer 1 and Buyer 2) and eight SME suppliers (Suppliers A through H). All eight suppliers (Table 4.1) provide indirect products and services, have been in operation for 18 years or more, and qualify as SMEs including two very small firms (Suppliers F and G).These suppliers sell either to Buyer 1 or to Buyer 2 and in some cases to both buyers (Suppliers A and H) as indicated in the last column of table 4.1, thus forming 10 dyads.

Table 4.1 : Firms involved in the multi-case study

Company	Products/services	Since	Annual revenues	Number of employees	Sells to
Supplier A	Industrial recycling	1989	$15M	130	Buyer 1 Buyer 2
Supplier B	Machining; Equipment manufacturer	1986	-	40	Buyer 1
Supplier C	Turnkey projects; Drilling platforms	1988	$20M	210	Buyer 1
Supplier D	Machined casting	1976	$4M	30	Buyer 1
Supplier E	Production of castings	1988	$8M	50	Buyer 1
Supplier F	Distribution of industrial batteries	1985	$1.3M	5	Buyer 1
Supplier G	Distributor of industrial glass	1982	$3M	10	Buyer 1
Supplier H	Turnkey industrial equipment	1972	$25M	80	Buyer 1 Buyer 2

The four e-marketplaces involved in the study are presented in Table 4.2. An e-marketplace is defined as a platform whose purpose is to electronically link many trading partners together through a centralized electronic system. A market can be either vertical, if it specializes in answering the need of a specific industry, or horizontal, if it specializes in supporting a business activity, such as purchasing, across all industries.

Table 4.2 : The e-marketplaces encountered in the multi-case study

Electronic marketplaces	Specialization	Market	Owner	Used by
e-Marketplace 1 (invitation only)	Metal industry	Vertical	Consortium (Buyer 1, Buyer 2 and others buyers)	Buyer 1
e-Marketplace 2	Electronic reverse auctions	Horizontal	Third party (public)	Buyer 1 Buyer 2
e-Marketplace 3 (invitation only)	Specific to Buyer 2's needs	Vertical	Buyer 2 (private)	Buyer 2
e-Marketplace 4	National metal industry	Vertical	Third parties (public)	Not used by any organization studied

The researchers restricted their analysis exclusively to data related to the primary metal industry: this was done to eliminate the influence of other industries because industry factors seem to influence the use of e-commerce in many ways (Fillis et al. 2004). In fact, SMEs in different sectors may adopt different strategies for e-commerce (Drew, 2003),(Daniel et al. 2002) and industry plays an important role in determining the e-commerce technology used (Chan and Swatman, 2004) and the degree of e-commerce integration the SME will have (Daniel, 2003). Finally, special attention was paid to ensuring that both perspectives (the buyers' and suppliers' perspectives) were included in the study, as is recommended when analyzing a dyadic relationship (Izquierdo and Cillán, 2004), especially since the two parties may have diverging opinions on the use and impact of IT on the business relationship (Leek et al. 2003b).

4.4. Research Findings

The main research goal was to discover some interesting insights into electronic interactions. Common patterns among the firms involved in this field study appeared by themselves through the data collected, which is highly consistent with grounded work (Glaser and Strauss, 1967).

4.4.1. Current electronic interactions

As mentioned earlier, the study took place in the context of a very influential buyer (Buyer 1) pressuring its suppliers to adopt e-commerce, mostly through an industry e-marketplace (e-Marketplace 1) owned by a consortium of important buyers. E-Marketplace 1 is a separate entity with its own responsibility for profits and losses, although it is owned in part by Buyer 1 and Buyer 2.

Figure 4.1 presents all the organizations involved in the field study and their current electronic interactions. Both buyers (right side of Figure 4.1) hold significant power and influence. Buyer 1 is considered particularly influential for three reasons. First, it is disproportionately larger than its suppliers and is active on foreign markets. In fact, Buyer 1 is listed on international stock exchanges while the suppliers studied are SMEs with regional operations. Secondly, Buyer 1 accounts for a significant proportion of their annual revenues (40% for Supplier H; 25% for Supplier F). Thirdly, Buyer 1 represents a major source of employment for the local economy. Buyer 2 is equivalent to Buyer 1 in size and influence. The suppliers (left side of Figure 4.1) attempt to align their e-commerce strategies with their major customers, either on their own (Suppliers A, B, C, D and E) or through a coalition (Suppliers F, G and H). The aim of the

Coalition (an independent organization) is to facilitate e-commerce adoption and use among its members.

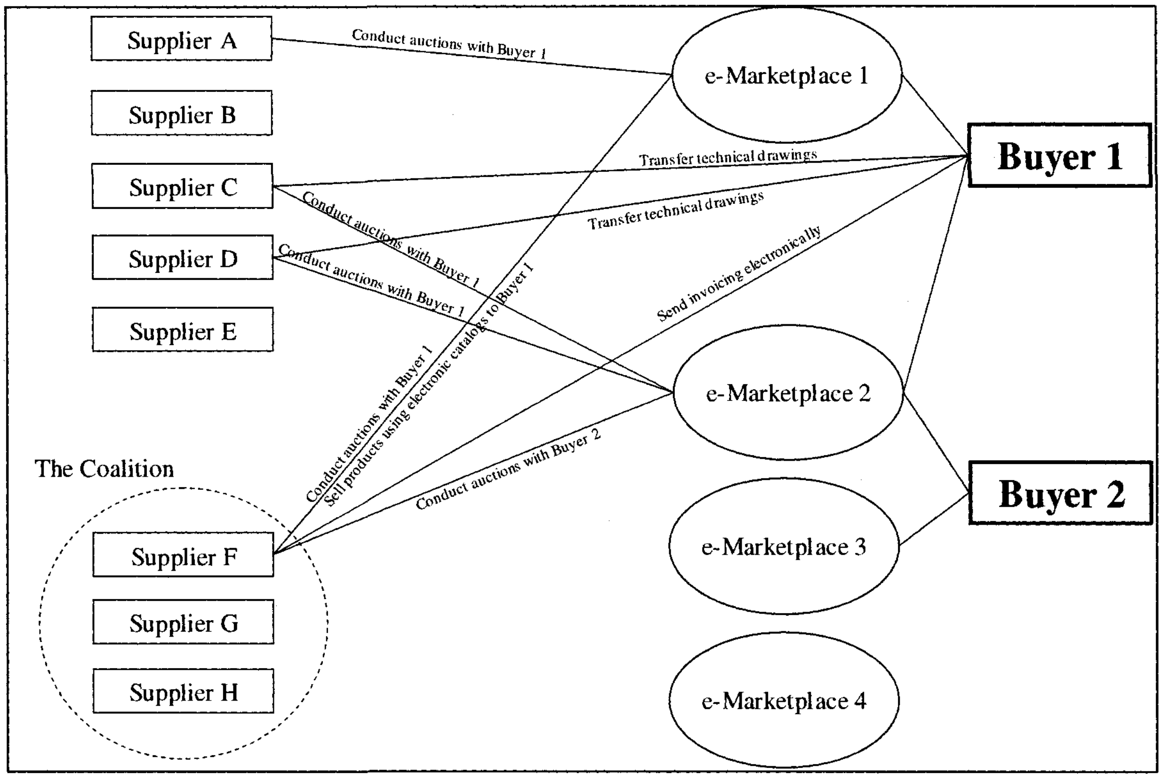

Figure 4.1: E-commerce interactions that had already been performed at the time of the study

As shown in Figure 4.1, Suppliers C, D, and F already have direct electronic interactions with the buyers. Suppliers A, C, D and F have interactions on the e-marketplaces. Supplier F has the most fully developed e-commerce strategy: it conducts auctions on e-Marketplace 1 with Buyer 1, sells products using electronic catalogs to Buyer 1 on e-Marketplace 1, sends invoices electronically directly to Buyer 1 and takes part in auctions with Buyer 2 on e-Marketplace 2. Suppliers B, E, G, and H engage in no electronic interactions with Buyers 1 and 2, although they have been asked to do so by the buyers. E-Marketplace 3 is not used by any of the suppliers at present. E-Marketplace 4 is not used by the buyers or the suppliers.

Some suppliers have expressed concerns about and even resistance to the two buyers' requirements. Lack of trust seems to be an important explanatory factor, as indicated by the following comments:

Comment from the Coalition:

> *First Buyer 1 wanted its suppliers to implement ISO and said that they would lose Buyer 1's business if they didn't comply. So some suppliers complied. Then, Buyer 1 said the same thing about EDI. Again some suppliers complied. The problem is that most of their other suppliers didn't follow. Now Buyer 1 no longer lists those two requirements as mandatory. The suppliers who complied basically implemented ISO and EDI for nothing. Now the same thing is going to happen with e-Marketplace 1. Buyer 1 says that it won't do business with our members if they don't adopt the e-marketplace. I don't believe it.*

Comment from Supplier C:

> *I don't want to adopt e-Marketplace 1! No matter how long you've done business with Buyer 1, it doesn't matter anymore. They're pitting supplier against supplier. They don't care how much we've invested in our past relationship. Buyer 1 just wants to squeeze us some more.*

4.4.2. Identifying the required B2B electronic interactions

All the suppliers knew of the new requirements from the two buyers. After several rounds of interviews, we found that these requirements could be structured at two levels: compliance with electronic business processes and compliance with the use of specific technologies (see Table 4.3). For example, Buyer 1 required that its suppliers "invoice through EDI," "submit a request for proposal on e-Marketplace 1," "sell on e-Marketplace 1," etc. In such cases, the supplier does not have the possibility of choosing the technology since the buyer has already decided on it and integrated it into its own internal systems. Being able to perform a process through a different electronic medium (e.g., invoicing by e-mail when is the buyer specifies that it must be done through EDI) is not enough to properly meet the requirements. Conversely, being able to handle the correct technology without being able to perform the required process is not sufficient. For this reason, each required electronic interaction was defined as a mix of business process and e-commerce technology coupled together. Table 4.3 provides a clearer overview of these interactions.

Table 4.3 : Electronic interactions required by the buyers

Electronic business processes:	**Performed through this e-commerce technology:**
Convert information on products/services into digital form.............	...with a Computer-Aided Design (CAD) tool
Transfer documents and technical drawings to customers...............	...by e-mail
Sell products/services by electronic reverse auctions.......................	...on e-Marketplace 1
Sell products/services by electronic reverse auctions.......................	...on e-Marketplace 2
Sell products/services by responding to electronic calls for tenders	...on e-Marketplace 1
Sell products/services by responding to electronic calls for tenders	...on e-Marketplace 2
Sell products/services using electronic catalogs..............................	...on e-Marketplace 1
Sell products/services using electronic catalogs..............................	...on e-Marketplace 3
Send invoices electronically..	...through Electronic Data Interchange (EDI)
Manage orders electronically...	...on e-Marketplace 1
Manage orders electronically...	...on e-Marketplace 3
Receive payments electronically..	...through a wire transfer

4.4.3. The link between B2B electronic interactions and buyer-seller relationships

Our next finding was that Suppliers A through H were being given divergent requirements by Buyer 1. They were being asked to implement different business processes and different technologies from one another. Was Buyer 1 using a supplier classification in order to determine its required electronic interactions? The researchers interviewed Buyer 1's high-level managers who were directly responsible for the e-commerce initiatives. Buyer 1 insisted on the overriding importance of cost reductions in the context of foreign markets, and explained how these cost reductions could be achieved through e-procurement and how the electronic interactions with its suppliers should therefore be implemented. To do this, the suppliers were required to integrate specific electronic business processes with the specific corresponding technologies, thus validating our understanding of the required electronic interactions as presented in Table 4.3.

In order to more easily manage the disparate e-commerce competency levels of its suppliers and the efforts needed to adapt to its requirements, Buyer 1 had set out a general path of e-commerce adoption for them. This path seems to follow different electronic interaction strategies based on the level of the buyer-seller relationships. Each relationship level has its own unique electronic interactions that differ from those of the other levels. A very similar picture emerges from the on-site interviews with the executives of Buyer 2. Buyers 1 and 2 are essentially managing portfolios of electronic interactions according to their suppliers' e-commerce readiness, allowing suppliers to move along the path to the next step once the requirements for the current steps are met. To some extent, these steps act as a test for the supplier as it must demonstrate that it has successfully adapted before the buyer-seller relationship can begin or grow. Once a new relationship level is achieved, other requirements come into play, as illustrated in Figure 4.2. The complexity and confusion that the suppliers initially experienced originates in part from the fact that they were considering all of the requirements for all of the relationship levels at the same time. When these are analyzed by relationship level, they seem less complex and more accessible.

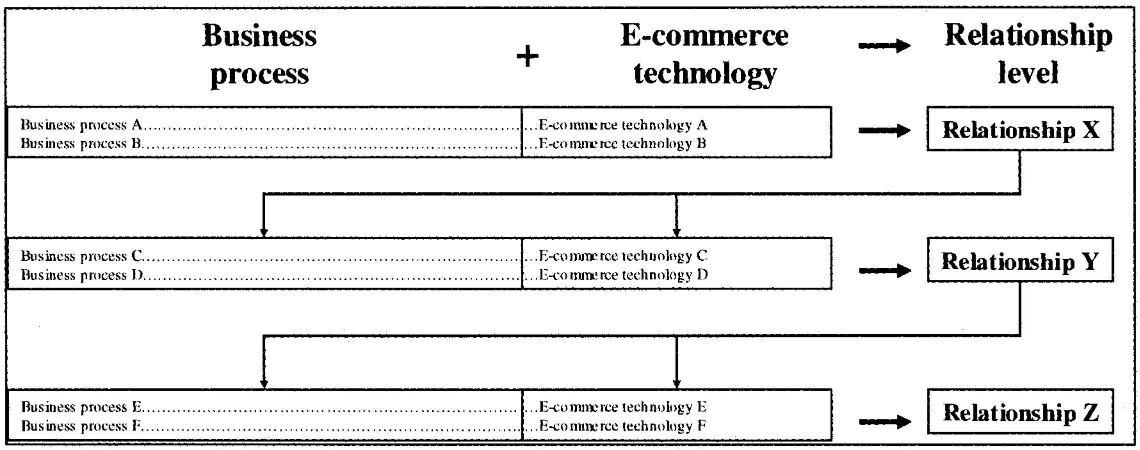

Figure 4.2 : The emergence of a path for B2B e-commerce adaptation

The e-commerce adaptation path revealed by the data from the field study needed further investigation. In particular, the different relationship levels and the corresponding electronic interactions were thoroughly validated during focus groups where senior managers from the suppliers and the buyers got together with the researchers to attempt to associate each potential electronic interaction with the appropriate relationship level. A consensus was reached on four relationship levels: the pre-relationship level, the spot relationship level, the contractual relationship level and the collaboration relationship level. These are presented at the right-hand side of Figure 4.3. For each level, certain electronic interactions were agreed upon by both the suppliers and the buyers. The only exception was for the pre-relationship level where the input from buyers was predominant: since all the suppliers involved in the field study are already current suppliers of either Buyer 1 and/or Buyer 2, they had already passed through the pre-relationship level quite a few years ago, before the new requirements even became a concern.

Figure 4.3 also presents Buyer 1's requirements. No electronic interactions are required for the pre-relationship level. For a successful spot relationship with Buyer 1, suppliers are required to "Sell products/services by responding to electronic calls for tenders" and "Sell products/services by electronic reverse auctions" on e-Marketplaces 1 or 2. At the contractual relationship level, they are required to "Sell products/services using electronic catalogs" and "Manage orders electronically" on e-Marketplace 1, "Send invoices electronically through EDI," "Convert information on products/services into digital form with a CAD tool" and "Transfer documents and technical drawings to customers by e-mail." Finally, no specific electronic interactions currently seem to be required at the collaborative relationship level.

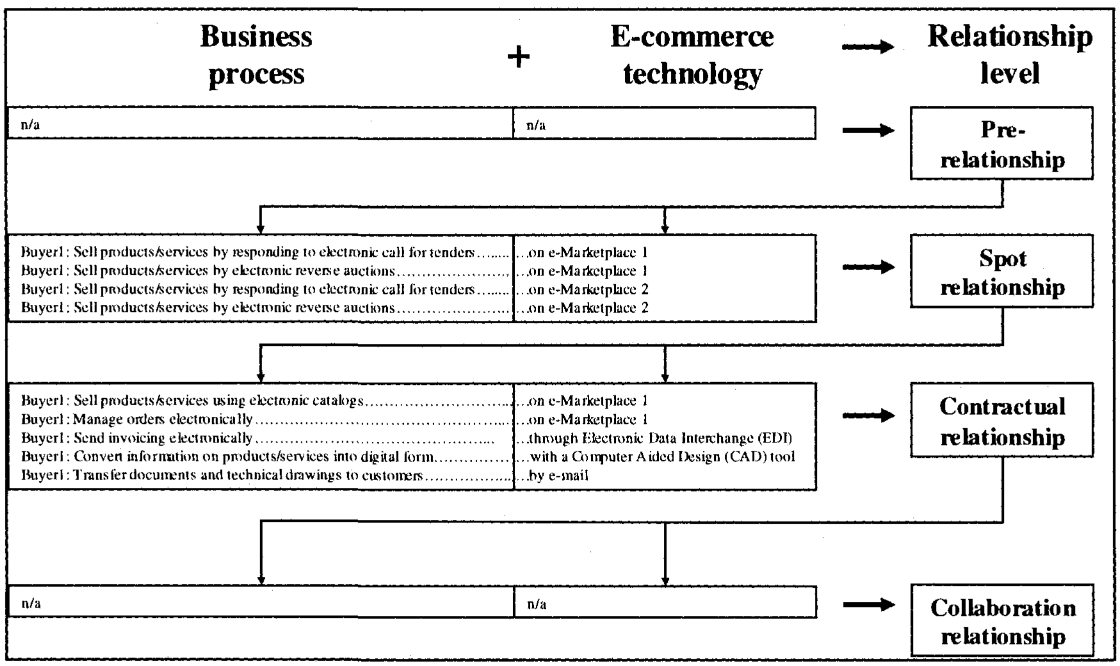

Figure 4.3 : The link between the required B2B electronic interactions and Buyer 1's relationship levels

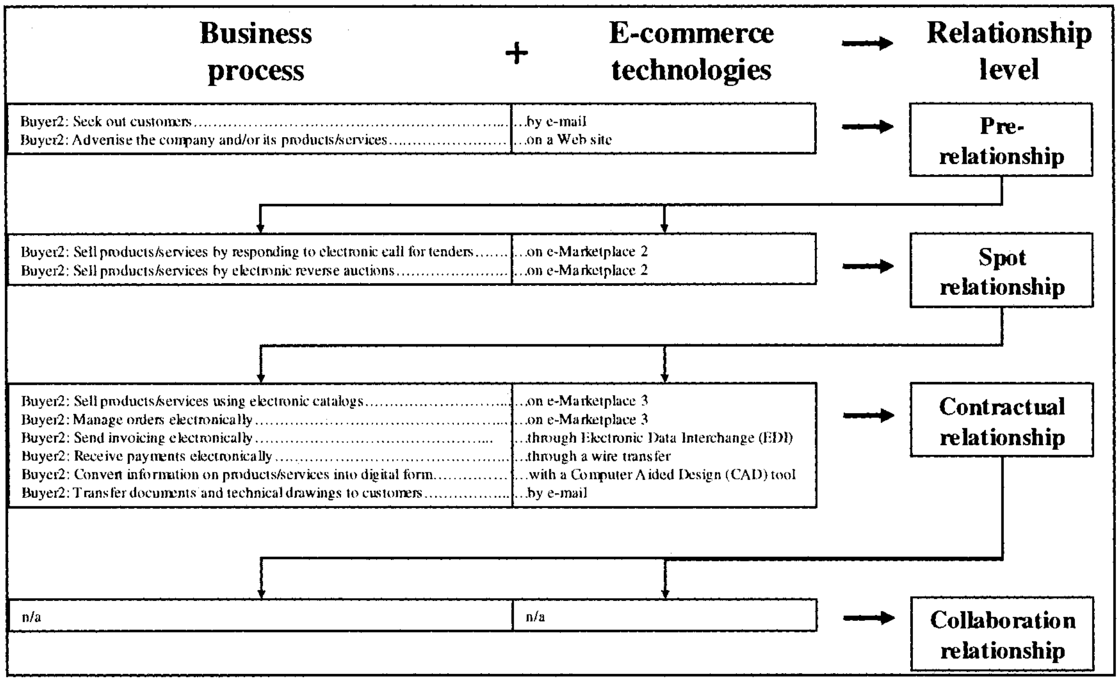

Figure 4.4 : The link between the required B2B electronic interactions and Buyer 2's relationship levels

Similarly, Figure 4.4 displays Buyer 2's requirements before reaching the different relationship levels. When one compares Buyer 1's requirements (Figure 4.3) to Buyer 2's requirements (Figure 4.4), the resulting models are very similar. Considering only the business process component of the electronic interactions, both require that their suppliers "Sell products/services by responding to electronic calls for tenders" and "Sell products/services by electronic reverse auctions" to achieve a spot relationship level. Both also require that suppliers execute some of the following business processes to achieve a contractual relationship level: "Sell products/services using electronic catalogs," "Manage orders electronically," "Send invoices electronically," "Convert information on products/services into digital form" and "Transfer documents and technical drawings to customers." Buyer 2 has only a single additional business process requirement for this relationship level: it requires its suppliers to "Receive payments electronically." The main difference between the two buyers is at the pre-relationship level, where Buyer 1 requires no specific electronic interactions from its potential suppliers. Buyer 1 and Buyer 2 also resemble each other in terms of the e-commerce technologies that enable their business processes. They differ slightly, mainly in the fact that when Buyer 1 requires that a transaction take place on e-Marketplace 1, Buyer 2 will require instead that it take place on e-Marketplace 2 and eventually on e-Marketplace 3. Although these transactions must be executed on different platforms, they are still e-marketplaces and thus similar in structure.

The authors recognize that not all suppliers will necessarily follow all four steps through the model displayed in Figures 4.3 and 4.4. The model is a general one that represents how most suppliers are required to adapt to the buyers' electronic interactions in the primary metal industry. E-marketplaces open up the competition to potential domestic and foreign suppliers: for instance, a potential supplier that had solicited Buyer 2, but had not yet done business with it (pre-relationship level) was invited to participate to an electronic reverse auction. The supplier made the winning bid, which initiated an isolated transaction with Buyer 2 (spot relationship level). Buyer 2 was very satisfied with this particular supplier and has recommended it to its international business units. This particular supplier could eventually engage in more established relationships (contractual relationship level), if it continues to meet expectations. Buyer 1 also indicated that companies that are not current suppliers (pre-relationship level) can participate in auctions. Non-suppliers may be awarded the contract (spot relationship level) should they outbid their competitors. Once a relationship is established and transaction volume increases, they will be asked to participate in the electronic catalog program (contractual relationship level). Furthermore, if their skills are transferable, they can even become more than local suppliers (collaboration relationship level).

4.4.4. Strategies used at the different relationship levels

4.4.4.1. At the pre-relationship level

At the pre-relationship level, no transaction has yet been conducted between the buyer and the supplier. The goal of this relationship level is that the buyer should become aware of what a potential supplier has to offer.

4.4.4.1.1. Buyer Strategy

From the perspective of the buyer, the pre-relationship level is an opportunity to contribute to cost savings by evaluating potential suppliers more efficiently through pre-defined electronic tools. Buyer 2 requires potential suppliers to complete a Web-based registration form, thus "advertising the company and/or its products/services on a Web site" (Figure 4.4). This form contains standardized categories that are used to evaluate the potential suppliers that are now entered in the buyer's database and can be called upon when the need arises. This process also ensures a reduction in search costs associated with finding a new supplier.

4.4.4.1.2. Supplier Strategy

From the perspective of the supplier, the goal is to advertise its products and services through the electronic medium that the buyer will use. Unfortunately, it is not always clear to the suppliers how they can identify what form of electronic interaction is required at the pre-relationship level. As the field study discovered, many conflicting messages can prevent the suppliers from achieving a pre-relationship level with the buyers. For example, e-Marketplace 1 was recruiting Buyer 1's suppliers by informing them that they would be able to advertise their products and companies on the e-marketplace. E-Marketplace 1 was also using as its main selling argument the claim that, once the suppliers were linked to the e-marketplace, they would be contacted by many other buyers. During our study, another vertical e-marketplace for the same industry was created, e-Marketplace 4, which also argued that SME suppliers could do business with large buyers if they registered with it. When we interviewed Buyer 1, our respondent clearly indicated that it used neither e-Marketplace 1 nor e-Marketplace 4 to contact potential suppliers, as shown by the absence of electronic interactions in its pre-relationship level (Figure 4.3). Buyer 2 also confirmed that it did not use these two e-marketplaces to find new suppliers (Figure 4.4).

4.4.4.2. At the spot relationship level

At a spot relationship level, there is an intermittent relationship, but no mid- to long-term agreement between the buyer and the supplier. Our field study led us to use the term "spot relationship" to describe this relationship level in the primary metal industry because spot purchasing interactions are often observed. At this relationship level, the focus is on reducing the price paid for goods and services while decreasing procurement cycle time and improving sourcing processes. This is generally recognized to be the case in a B2B setting (Beall et al. 2003). With the use of Internet technologies to enable efficient communications and auction tools, electronic reverse auctions are encouraged. This is especially true of standardized commodities and also for custom items with low complexity. Since price is the key performance measurement, it is no surprise that the relationship is adversarial in nature (Cousins and Spekman, 2000) and that the development of deep relationships is not the goal, which is consistent with previous research on the subject (Hartmann et al. 2002).

4.4.4.2.1. Buyer Strategy

From the perspective of the buyer, the main advantage is the lower cost of procuring products and services. Buyer 1, for example, invites a group of suppliers to participate in an electronic reverse auction by first sending out a Request for Quote (RFQ) on e-Marketplace 1 or e-Marketplace 2 (Figure 4.3). The auction then begins from the lowest quoted price obtained in the RFQ. The price lowers incrementally until one supplier outbids the others. The payment is then sent through a traditional wire transfer. Buyer 1 used both e-Marketplace 1 and e-Marketplace 2 because it was transitioning from the public e-Marketplace 2 towards the preferred private e-Marketplace 1. This transition was motivated by Buyer 1's part ownership of e-Marketplace 1 (Table 4.2). Buyer 2 uses roughly the same process, but the starting price is the historically lowest price and bids are made on e-Marketplace 2 instead of e-Marketplace 1 (Figure 4.4). Buyer 2's procurement director claimed to have achieved an average 24% decrease in prices through electronic reverse auctions on e-Marketplace 2. Although this average seems to diminish over time as the savings rate cannot be sustained, the director has implemented an electronic reverse auction quota for all of Buyer 2's purchasing agents. They are to engage in at least one auction per week. Since this process has had such a significant impact, the procurement director intends to roll these procurement practices out to other domestic business units. Although Buyer 2 is also a part owner of e-Marketplace 1, it has no plans to operate on that platform.

The spot relationship level is also used to test potential and current suppliers. Buyer 2 uses this level to purge or reset stale relationships by asking current suppliers to bid in auctions against new entrants. If the incumbent supplier loses many consecutive auctions or if Buyer 2 did less than $5000 of business with the supplier during the previous year, then it is cut off from the list of current suppliers. At the same time, this relationship level enables Buyer 2 to qualify potential new suppliers identified at the previous pre-relationship level before allowing them to become established suppliers. If the potential supplier wins an auction and fulfills its obligations correctly, it can be invited to enter a longer-term contractual relationship: As Buyer 2 said, "*One potential supplier really surprised me. We had never done business with them before. They won the bid and are now one of our regular suppliers.*" Buyer 2 also uses this process to stimulate innovation among its current suppliers by testing them against new entrants, and made the following comment: *"Auctions are great. You can force learning onto your suppliers by introducing new blood. Some of our current suppliers just aren't trying anymore. They're taking us for granted. They believe that once you have a contract with Buyer 2 you don't have to work on the relationship or innovate any longer. Auctions force our suppliers to stay on their feet."* To lower existing prices with electronic reverse auctions, Buyer 1 uses RFQs while Buyer 2 pits new entrants against its incumbent suppliers. The end result is identical: both buyers are redefining the rules for their current suppliers.

4.4.4.2.2. Supplier Strategy

From the perspective of the supplier, quality and service are increasingly regarded as givens. Their differentiation strategy mainly focuses on price, as current suppliers see their margins squeezed (Gulledge, 2002). This causes frustration as they feel that previous investments in the relationship with the buyer have been forgotten. It is therefore no wonder that some suppliers refuse to adapt to their buyer's requirements at this relationship level. For example, Supplier B preferred to invest in new machining equipment to differentiate its products rather than conduct electronic interactions with its buyers. After losing many auctions, Supplier C now refuses to participate in any form of online auction. Other disgruntled suppliers also wonder whether their competitors are selling below cost as prices lower incrementally during the auction. While the researchers did not meet suppliers that admitted to selling below cost, they did find some suppliers that barely made any profit from their sales. These companies justify their low margins as "relationship building." Buyer 2 claims that this is one of the main advantages for potential suppliers as they can achieve a spot relationship level by successfully using electronic reverse auctions and thus acquire a first transaction with the buyer. Some current suppliers have therefore significantly lowered their profit margins in the hope of winning the auction and making the relationship grow or at least continue. The acceptance of short-term burdens in the expectation of longer-term benefits, defined as a futuristic orientation (Ellram and Cooper, 1990), enables some suppliers who have successfully achieved a spot relationship level to reach a contractual relationship level. An example of this phenomenon is Supplier F, which has sometimes lowered its profit margins at the spot relationship level in the hope of winning the auction and expanding the relationship. This is illustrated by the following remark by Supplier F, talking about a first win with Buyer 2: *"I may not be making a lot of money in the reverse auction arena, but my hope is to get my foot in the door. Once I'm in and they see how good we are, I can become a long-term partner."*

There are instances in which the suppliers are content with the profitability obtained from these electronic interactions. This is exemplified by the suppliers who regularly win their electronic reverse auctions. Supplier A is one of them. It had just hired its first marketing employee, a young and very technology-savvy graduate who insisted that all decision-makers at every level be present around the computer during the bidding. Supplier D has also been winning its electronic reverse auctions. Each time, it had prepared very well by calculating several financial scenarios for the auction beforehand. Another supplier, Supplier F, has also had many successful auctions. It also points to preparation and the availability of decision-makers as important success criteria. Supplier F even involved its own supplier in the auction. "*When the price went below my breaking point, I called my supplier, whom I had asked to be on stand-by. I told him 'If we lose, then you do too. Can you give us a better price so we win this deal together?' He did. So we won.*" Supplier F has another advantage during auctions. The individual who represents Supplier F in the auctions was previously employed by Buyer 1 and was responsible for facilitating the adoption by its suppliers of e-Marketplace 1. Such experience and knowledge of the buyer's inner workings could certainly provide an advantage to Supplier F in winning auctions. For example, Supplier F deduced the identity of the competitor that was bidding against it even though it was a blind auction.

4.4.4.3. At the contractual relationship level

The general description of this relationship level in the primary metal industry is similar to the buyer-seller relationships found in the U.S. automobile industry (Mudambi and Helper, 1998). These "close but adversarial" relationships represent formal cooperation accompanied by non-cooperative behavior. The contractual relationship level takes its name from the fact that a 3- to 5-year contract is signed in order to meet a constant need for a product or service involving substantial volumes, repetitive transactions or increased product customization. The recurring purchases are made on the basis of the pre-negotiated prices. To reach this relationship level, the electronic interactions demand a form of commitment by the supplier because it must invest in specific assets (Bensaou, 1999) such as an EDI network when the frequency of transactions is high (Iskandar et al. 2001a). As this relationship level progresses, investments become more specific and eventually the supplier's internal information systems are integrated with the buyer's.

4.4.4.3.1. Buyer Strategy

From the perspective of the buyer, the main objective of this relationship level is to optimize the procurement process by automating repetitive transactions and thereby considerably reducing transaction costs. Before asking their suppliers to invest in electronic interactions, the buyers verify the supplier's long-term relationship potential. For example, a supplier must already have a long-term contract with Buyer 1, while Buyer 2 only invites suppliers of products and services with a high volume of transactions to add their products to its procurement catalog. For both Buyer 1 (Figure 4.3) and Buyer 2 (Figure 4.4), this translates into electronic interactions that require their suppliers to "Sell products/services using electronic catalogs" and "Manage orders electronically" on specific e-marketplaces as well as to "Send invoices electronically through Electronic Data Interchange (EDI)." In addition, Buyer 2 has streamlined the payment process associated with these activities by requiring that its suppliers "receive payments electronically through a wire transfer" (Figure 4.4). Buyer 2 also indicated that this relationship level had an important impact on roles and responsibilities within its organization. On the production floor, factory workers now order a product or service directly through a console when the price is less than $500. In these cases, the task of purchasing is now the responsibility of the product's end user. The employee who used to be the purchasing agent is now a "negotiator" who is free of repetitive tasks and can focus on more strategic initiatives. Driven by a long-term strategy, the buyers develop a more formalized and less personal relationship (Hartmann et al. 2002) because the human factor is taken out of daily interactions. When dealing with customizable products, both buyers also require that suppliers "convert information on products/services into digital form with a Computer-Aided Design (CAD) tool" and "transfer documents and technical drawings to customers by e-mail" (Figure 4.3 and Figure 4.4), for example between Supplier D and Buyer 1 (Figure 4.1). This process improves the quality and speed of interactions when dealing with such products.

Even though the relationship between the buyer and a given supplier has evolved, the pressure associated with this relationship level is still quite strong. Not being able to adapt means losing the relationship with the buyer. Buyer 2 had already replaced several long-time local suppliers with international suppliers because the latter already had electronic catalogs and "selling products/services using electronic catalogs on e-Marketplace 3" is one of its requirements (Figure 4.4). Although it would rather purchase locally, the lack of local e-commerce capabilities is pushing Buyer 2 to purchase abroad. Buyer 1 also noted that not adapting meant losing it as a client, thus clearly demonstrating that its requirements are prerequisites for attaining and maintaining this relationship level: *"If our suppliers want to continue doing business with us, they will have to do it on e-Marketplace 1. We are ready to assist them if they require it and we won't be renegotiating our contracts, but they will have to use e-Marketplace 1."*

It is interesting to note that Buyer 2 requires its suppliers to migrate from e-Marketplace 2 to e-Marketplace 3 when transitioning from a spot relationship level to the contractual relationship level (Figure 4.4). A change of e-marketplace during this transition is not necessary, as demonstrated by Buyer 1, which uses e-Marketplace 1 in both levels (Figure 4.3). After all, Buyer 2 could decide to use the same B2B e-commerce strategy as Buyer 1 and consolidate all e-marketplace activities on e-Marketplace 1, which it owns in part (Table 4.2). It has, however, chosen not to follow this direction. As the buyer-seller relationship evolves, Buyer 2 encourages its suppliers to use its private trading exchange, to which no other buyer has access, thereby ensuring more control over electronic interactions and the relationships. This could eventually allow a more private relationship with the suppliers in order to provide a greater potential for added-value initiatives. Such a relationship level could be collaborative in nature.

4.4.4.3.2. Supplier Strategy

From the perspective of the supplier, the lower-than-desired margins of a contractual relationship are compensated by the volume of business negotiated over the long term. However, moving from a spot to a contractual relationship level implies investing in new technologies, developing new competencies, reengineering existing business processes and adopting new ones. As Supplier F mentioned, initially costs are much higher at this relationship level and there are few benefits as all processes are manually re-entered on e-Marketplace 1 and therefore duplicated. The fact that Buyer 1 and Buyer 2 require their suppliers to "sell through e-catalogs" (Figure 4.3 and Figure 4.4) implies that the supplier must digitize its products, maintain an accurate database of its products and services and eventually link its system to the specified e-marketplace where the catalogs are hosted. Supplier F plans to eventually move from a hosted Web-based platform and integrate its systems directly with e-Marketplace 1. Once this is done, Supplier F believes it will benefit from transaction cost savings.

The contractual relationship level seems to offer more advantages to suppliers than the earlier relationship levels. Buyer 2 believes that once a supplier's products or services are linked to its catalog, the supplier will have a competitive advantage. Since the two organizations are electronically linked, the supplier will automatically receive orders for the next few years. Supplier F also believes this to be the case and invested in the earlier relationship levels in order to reach the contractual relationship level and be invited to "Sell products/services using electronic catalogs on e-Marketplace 3" with Buyer 2 (Figure 4.4). This initiative may also come from the supplier, but it is still heavily dependent on the buyer's agreement. For example, Supplier A asked for permission to "sell products/services using electronic catalogs on e-Marketplace 1" (Figure 4.3) by adding its products to Buyer 1's electronic catalog. Buyer 1 declined, even though both organizations have shared in several projects. Additional benefits for suppliers that reach a contractual relationship level can include improved cash flows with Buyer 2. By requesting that its suppliers "receive payments electronically through a wire transfer" (Figure 4.4), it has been able to implement a "Pay-From-Receipt" (or "Pay-On-Receipt") program in which billing is no longer necessary. Once the shipment has arrived at Buyer 2's location, the supplier simply withdraws the money directly from Buyer 2's bank account within 24 hours.

4.4.4.4. At the collaboration relationship level

A collaboration relationship exists when some form of cooperation is involved. Trust is usually a prerequisite as benefits and information are shared. One of the main reasons for entering into a collaboration relationship is cost reductions (Cousins and Spekman, 2000). For example, Supplier F sends an employee to Buyer 1's local and remote locations every week to take inventory levels because it has a Vendor Management Inventory program. It has offered to gather the information at shorter intervals through an electronic link with Buyer 1. The main benefits would be better inventory control for Buyer 1 and lower costs for Supplier F. Another possible reason for collaboration is to create synergy while engaging in shared opportunities. Supplier B had approached Buyer 2 to develop a joint venture to build a promising new product. Although many authors recognize its existence (Lejeune and Yakova, 2005; Batonda and Perry, 2003; Hoyt and Huq, 2000; Jassawalla and Sashittal, 1998) and even identify it as a source of competitive advantage in the new economy (Spekman and Carraway, 2006), we found no instances of the collaboration relationship level in our study. In the above examples, Buyer 1 refused to give electronic access to its inventory levels to Supplier F, and Supplier B claims that its idea was later stolen by Buyer 2. However, the existence of the collaboration relationship level was hinted at by Buyer 1 when it claimed that very good suppliers can achieve more than a contractual relationship.

4.5. Discussion and Conclusion

Our findings indicate that the requirements to which suppliers must adapt are closely linked to the level of relationship they have with their buyers. When a supplier does adapt to these requirements, the relationship can evolve and, as it evolves, the requirements change again. If the supplier does not adapt, then the relationship may stall or be halted. Thus, our evolving B2B e-commerce adaptation model suggests that (1) B2B e-commerce adaptation feeds back into the relationship, thereby increasing cooperation; (2) substantial adaptation can be incremental over time; and (3) there is a link between adaptive behavior and the stage of development of the relationship. Our findings also raise some interesting implications that answer the fundamental questions raised earlier.

4.5.1. Why do SME suppliers seem to be adapting to B2B e-commerce so slowly and unresponsively?

By comparing the similarities and differences among e-commerce requirements from the two buyers we studied, one can observe that they request similar electronic business processes from their suppliers at each relationship level. However, the technological platform on which they must be conducted differs. These differences sometimes create conflicting requirements at each relationship level. Because a supplier must interact with many different buyers, it must therefore adapt to many different requirements at each relationship level. This multi-faceted adaptation demands more effort than adaptation to a single e-commerce strategy. In addition, each relationship will evolve, thus creating a mix of many different evolving e-commerce requirements; the result is complexity, which the supplier must be able to manage. For example, Supplier F is at different relationship levels with the two buyers, and thus faces the need to manage multiple business processes with multiple technological tools on multiple e-marketplaces. E-commerce adaptation from the perspective of the supplier SME, which is strongly influenced by its larger trading partners, can seem paradoxically discouraging. This additional strain on SMEs' already limited resources could be one of the factors contributing to a lower e-commerce adoption rate.

4.5.2. How valuable are previous relationship investments?

In our study, electronic interactions have been found to challenge and even modify the existing relationships between buyers and their suppliers. For example, the relationship between Supplier C and Buyer 1 is tense because Supplier C refuses to go any further in complying with the requirements for electronic interactions whereas Buyer 1 has clearly stated that this means an end to all interactions. Similarly, Buyer 2 has redefined its supplier base by using its requirements to purge stale relationships. As such, fewer relationships remain and the remaining ones are more technologically integrated and automated and simpler to manage. At the contractual relationship level, electronic interactions are less direct and more dehumanized as they are conducted through machine-to-machine interfaces. Indeed, Buyer 2's purchasing agents no longer have day-to-day contacts with their suppliers because purchase orders are sent directly on e-Marketplace 3. Facing this new reality that threatens to change the nature of the relationship and possibly even end it altogether, some suppliers feel that their previous relationship investments with the buyers are now worth less. This concern has also been voiced by members of the Coalition.

Since electronic interactions change existing relationships, how important are previous relationship investments and continued human interaction in this new environment? Are all previous investments in the relationship worthless? Will continued investments in the relationship be useful? Should suppliers strive to promote human interactions instead of adapting to electronic interactions, and thus avoid a change in relationship rules? The findings of our study indicate that previous relationship investments are valuable and still provide an advantage to the suppliers. Other things being equal, the buyers prefer to continue an existing relationship rather than start a new one, which clearly indicates that the existing relational capital is not worthless. Not only have both buyers stated their preference for maintaining their relationships with their current suppliers, but they are investing in helping them to adapt. Buyer 1 provides assistance by making its personnel available to work with its suppliers and Buyer 2 has organized conferences to educate them. The evolution of the relationship also depends on previous sales volume with Buyer 2 and a signed contract based on previous interactions with Buyer 1. These examples demonstrate that previous relationship investments are indeed a factor.

However, even though previous relationship investments still hold value, a current supplier that does not adapt to the requirements may be dethroned by a new entrant that does. Adaptation by new entrants provided them with an advantage that was greater than the incumbent supplier's relational capital. Several field observations support this claim. Buyer 2 will resort to a new supplier at the contractual relationship level if the current one does not have electronic catalogs. At the contractual relationship level, Buyer 1 will boycott existing suppliers that refuse to use e-Marketplace 1. At the spot relationship level, Buyer 2 will favor new entrants over existing suppliers if they adapt better to electronic auctions. One such new entrant, Supplier F, has reduced its margins to gain a spot relationship with Buyer 2. This indicates that adapting to the requirements also generates relational capital. This does not imply that human interactions are no longer important. Supplier F believes that they will always be essential. When it won its bid with Buyer 2, Supplier F had performed the pre-relationship level processes by phone, thus bypassing the electronic interaction of "Advertise the company and/or its products/services on a Web site" (Figure 4.4). As for Buyer 1, e-commerce requirements are completely non-existent at the pre-relationship level. At the contractual relationship level, a machine-to-machine system manages repetitive daily interactions while human interactions serve the purpose of managing the exceptions. This indicates that human interactions are still important and this seems to be especially true at the pre-relationship level.

4.5.3. Can power be applied to induce collaboration?

Several factors may explain why the relationships between the organizations involved in this field study did not reach the collaboration level. First, only 10 dyads were observed and analyzed. Although this sample is quite sufficient for a qualitative study, it limits the possibility of encountering the collaborative relationships. Another possibility is that collaborative relationships simply do not exist in the primary metal industry. Some authors (Quayle, 2003; Spekman et al. 1998) have already noted a lack of effective adaptation from traditional adversarial relationships to modern e-collaboration in the industrial sector. Furthermore, it is difficult to induce collaboration when the power of the trading partners is unbalanced. When a buyer is dominant, it will tend to be opposed to close relationships whereas the supplier will favor them (Izquierdo and Cillán 2004); a concrete example was observed when Buyer 1 declined Supplier F's proposal for collaboration. Some facilitators of the transition towards collaboration, such as trust (Spekman and Carraway, 2006), seem to be absent because previous relationship investments were not rewarded as expected. Trust does affect commitment in a relationship (Morgan and Hunt, 1994),(Izquierdo and Cillán, 2004) and commitment is important in relationship investments.

There is one final possible explanation for the absence of e-commerce requirements at the collaboration relationship level: perhaps the groups studied do perform collaboration activities, but not electronically. These activities are more complex than simpler transactional processes and therefore are usually adopted after a firm gains some experience with simpler electronic business processes (Lefebvre et al. 2005b). If this is the case, it is only a question of time before both buyers and suppliers are ready for electronic collaboration.

4.5.4. How can an SME supplier remain competitive?

Some of our findings are of particular value to managers of small and medium-sized enterprises that sell to large buyers. Many of the suppliers interviewed viewed the requirements of their larger business partners with skepticism, experienced confusion and, in some instances, became frustrated. First, it is important for SMEs to note that the "threats" made by the buyers are real, as many relationships have been abandoned. The path model illustrated in Figures 4.3 and 4.4 enables suppliers to see beyond the immediate requirements, helps them to formulate longer-term goals for future e-commerce adoption and allows them to develop their own B2B e-commerce strategies, thus reducing the initial confusion because of diverging requirements from different buyers. Since buyers now prefer to have fewer relationships (Buyer 2 has cut its supplier base by more than 70% in the last year alone), suppliers will also have fewer clients. A focus on fewer clients implies that each client relationship becomes more strategic for the supplier. By targeting where it spends its limited relational investments, the supplier can decide which relationships to continue, rather than letting that decision be made by the buyer, and can develop more focused e-commerce strategies. During the course of the field study, those suppliers that opted for rapid e-commerce dyadic adaptation or a "client-oriented e-commerce adoption" strategy were found to benefit from certain tangible advantages such as increased revenues and were able to move quickly through the relationship levels. When moving from one relationship level to the next, suppliers should aim for different goals. When trying to achieve a pre-relationship level, a supplier's objective is to position itself as a potential supplier. When it wants to move up to the spot relationship level, the supplier's objective is to acquire a first relationship by winning an electronic auction. In striving to achieve a contractual relationship, the supplier's objective is to secure the buyer by linking to its information systems, which will significantly reduce transaction costs for the buyer and thus create value and an entry barrier to competitive suppliers. Here are some useful best practices for these stages:

1. At the pre-relationship level: Suppliers need to be well informed so they can determine their buyers' requirements before engaging in specific electronic interactions. This knowledge can direct future e-commerce efforts and keep suppliers from being distracted by third parties that have their own agendas. The requirements can be validated directly with buyers, who regard this information as non-proprietary. In the case of Buyer 2, the information is publicly available on their website. Suppliers should also understand the electronic interactions in terms of the business processes used and technology. Human interactions are still very important and can accelerate interactions.

2. At the spot relationship level: Preparation is the key to achieving a successful spot relationship. Suppliers that won auctions recommend "doing your homework beforehand." They had all determined their ratios and price points before the auction started. They were aware of the current bid's financial ratios and the profit margins for possible future contracts with the same buyer. The ratios were programmed in a decision tool to allow for rapid changes in strategy. This tool can be very simple, as one supplier used an Excel spreadsheet in which it had built financial scenarios of the auction's possible outcomes. During the auction, the suppliers maintained their strategy and "stuck to their numbers" without letting the pressure and excitement from the bidding affect their decisions. They also all had decision-makers including key suppliers available on site or on call for rapid decision-making, which they called "dynamic decision-making."

3. At the contractual relationship level: Both Buyer 1 and Buyer 2 would rather purchase from existing local suppliers. Unfortunately, their current suppliers' e-

commerce adaptation is not sufficiently advanced to support integration into their supply chain. Therefore, in order to achieve its own cost reduction goals, Buyer 2 must purchase from international suppliers that have an electronic catalog. An interesting strategy for SME suppliers to meet the requirements of relationships at this level was presented by Buyer 2. Before investing large amounts to develop their own electronic catalog to be integrated to the buyer's information system, Buyer 2 recommends that the suppliers find out whether their distributor already has an electronic catalog. When this is the case, the supplier's catalog can be built on the basis of its distributor's existing catalog instead of starting a new one from scratch. Small suppliers can also pool their resources together to build a common electronic catalog. This was done by a cooperative undertaking of Buyer 2's SME suppliers. On the other hand, Buyer 1 has decided to invest in training its suppliers. Participating in the training sessions can facilitate the transition and provide information on the buyer's intentions.

This paper contributes to our understanding of the link between electronic interactions and the buyer-seller relationship by exploring the electronic interactions that influential buyers will oblige their SME suppliers to engage in and by explaining how these requirements evolve over time according to the level of the relationships. These requirements are prerequisites to achieving a desired relationship and also serve the purpose of testing the supplier. Paradoxically, once the supplier adapts to them, the relationship evolves, resulting in new requirements and thus requiring more adaptation, which takes the form of a strong positive circular feedback loop between B2B e-commerce adaptation and relationship levels. As buyer-seller relationships are being redefined, many suppliers are wondering whether their previous relational investments are still valuable to the buyers. They are. However, adapting to the electronic interactions is more valuable. When dealing with more than one buyer, business processes will generally be found to be similar for each relationship level whereas the e-commerce technologies will be slightly different. This makes e-commerce adoption even more complex, as the SME supplier may experience different but simultaneous and ever-changing pressures from each buyer. The model proposed in this paper can serve as a tool to align B2B e-commerce strategies and buyer-seller relationship levels.

CHAPITRE 5. RFID AND BUYER-SELLER RELATIONSHIPS IN THE RETAIL SUPPLY CHAIN

Abstract

Results from a three-year field study highlight the role of supplier-buyer relationships as both crucial antecedents that shape RFID infrastructure and the consequence of RFID implementation. Specifically, the impact on and of eight key dimensions was considered: communication/information sharing, cooperation, trust, commitment, relationship value, power imbalance, adaptation and conflict. The paper also positions open-loop RFID projects as Supply Chain Inter-Organizational Systems (IOSs) and presents a model to analyze such initiatives.

Keywords: Buyer-seller relationship, Radio-Frequency Identification (RFID), Inter-organizational system (IOS), Supply Chain Management (SCM)

Paper Category: Research paper

5.1. Introduction

Radio-Frequency Identification (RFID), a technology that facilitates the tracking and manipulation of physical items, is now a major technological trend. According to experienced early adopters, knowledgeable industry leaders and academic researchers, it facilitates collaboration between organizations (Cantwell, 2006; Lefebvre et al. 2006; Roberti, 2006); in this context, it constitutes a Supply Chain Management (SCM) enabling technology.

SCM is defined as the integration of business processes among companies that collaborate in an effort to bring a product, service or unit of information from the initial supplier to the final customer (Lambert et al. 1998; Mills et al. 2004). It has increasingly become the basis for competition (Angeles and Nath, 2000) between supply chains and networks (Gomes-Casseres, 1994). SCM provides many benefits including cost reductions (Spekman et al. 1998) and a collaborative advantage, rather than a competitive advantage (Chen and Paulraj, 2004). Within the supply chain, buyer-seller relationships are the individual links, the dyads, among companies that tie it together. Without these links, there would be no supply chain. They are therefore of paramount importance for SCM. In fact, a literature review of over 400 academic articles on SCM has placed these links at the center of supply chain management research (Chen and Paulraj, 2004).

At first glance, RFID seems to support the move from a more adversarial stance towards collaborative relationships. Paradoxically, though, this does not always seem to be the case, at least in the retail industry where RFID has attracted the most interest (LoPrinzi, 2006). RFID implementations between major retailers and their suppliers seem to be far from collaborative. Several preliminary anecdotes from the industry indicate that RFID tends to upset relationships (Fogarty, 2004; Romanow, 2004; Schwartz, 2004) rather than solidifying them. These contradictory observations warrant additional empirical research and serve to remind us that little is known of RFID's impact on buyer-seller relationships and even less is known of the impact of RFID on all of the buyer-seller relationships in an entire Supply Chain. The goal of this paper is therefore to improve our understanding of this issue by answering the research question: How do RFID and the buyer-seller relationships of an entire Supply Chain affect one another?

The paper is organized as follows. The next section will review the literature on how similar collaborative technologies have affected and been affected by buyer-seller relationships. Then the methodological approach will be presented. The results section will first present the model that was developed to organize the field data and communicate the findings. Then the findings will be presented, with a focus on the key issues that emerged from the field data. Finally, the paper will identify how the study contributes to academia and practitioners and how the key issues influence the dimensions of the buyer-seller relationship, concluding with suggestions for future research.

5.2. Literature Review

An RFID system can be briefly described as follows: an electronic tag containing historical, transactional or identifying data is affixed to or embedded in an object. The data is automatically downloaded wirelessly to a computer when the object nears the vicinity of an RFID reader. Once on the computer, the information can travel anywhere that is accessible by the Internet or on a private network.

5.2.1. RFID as an IOS

RFID is a wireless technology that facilitates the identification of products without requiring a line of sight (Kärkkäinen and Holmström, 2002). It has the potential to replace all scanning activities in the supply chain. It can be implemented in a "closed-loop" setting where it is used internally by a single company, for example, in an employee authentication system or an electronic antitheft system. It can also be implemented in an "open-loop" setting where it is used to improve the efficiency of a supply chain. This is the case for Wal-Mart and other early adopting retailers (Alan D. Smith, 2005). In this situation, RFID clearly fits its definition of an Inter-Organizational System (IOS): "an automated information system shared by two or more companies. An IOS is built around information technology, that is, around computer and communication technology, that facilitates the creation, storage, transformation and transmission of information. An IOS differs from an internal distributed information system by allowing information to be sent across organizational boundaries" (Johnston and Vitale, 1988).

RFID can also replace bar codes, a form of IOS application (Vlosky and Wilson, 1994). Furthermore, it acts as an enabler of business-to-business electronic commerce (Lefebvre et al. 2006), another form of IOS. IOSs structure the ties between companies by creating technological bridges among them that optimize information flow. Therefore, they can be thought of as a way of solidifying inter-organizational relationships or, at least, stabilizing them (Chae et al. 2005). In today's digitalized economy, IOSs are essential for a competitive supply chain as they lead to better firm performance (Byrd and Davidson, 2003). Because RFID can be considered as an IOS, the literature on IOSs' influence on buyer-seller relationships can provide some insight into our research question.

5.2.2. IOS and Buyer-Seller Relationships

Most studies perceive IOSs to be a positive influence on collaboration (Chae et al. 2005), but their impact on buyer-seller relationships can be either positive or negative (Angeles et al. 1998). In fact, trying to optimize SCM with an IOS technology can potentially be very disruptive to these relationships (Vlosky and Wilson, 1994), to the point that they may break down (Boeck et al. 2006; Stump and Sriram, 1997) and new supply chain dyads are formed (Boeck et al. 2006). Many researchers feel that additional research on the link between technology and buyer-seller relationships is needed (Deeter-Schmelz and Kennedy, 2004; Gemünden et al. 2003; Leek et al. 2003a; Rao and Perry, 2003; Ryssel et al. 2004).

Initial research on IOS and buyer-seller relationships has been conducted on different types of IOS, starting with EDI and bar codes and moving on to Internet-based technologies such as e-procurement, e-marketplaces and extranets. The different types of IOSs have some similarities but since each kind functions differently, they can potentially influence buyer-supplier relationships in different ways. The literature review will show how IOSs have influenced or been influenced by the buyer-seller relationship through eight of its key dimensions, presented in Table 5.1.

Table 5.1 : Eight key dimensions that characterize buyer-seller relationships

Key dimensions of buyer-seller relationships	**Definition**
Communication and information sharing	The amount, frequency and quality of the information flow between trading partners (Palmatier et al. 2006)
Cooperation	The willingness to undertake complimentary actions to achieve mutual goals (Palmatier et al. 2006; Wilson, 1995)
Trust	Confidence that the trading partner will uphold its obligations and act in the best interest of its partners (Palmatier et al. 2006; Wilson, 1995)
Commitment	An enduring desire to ensure that the relationship continues (Palmatier et al. 2006; Wilson, 1995)
Relationship value	The trade-off between the benefits and sacrifices perceived by a customer regarding all aspects of the relationship (Walter et al. 2000)
Power imbalance and interdependence	A trading partner's ability to influence the other partner to do something it normally would not do (Anderson and Weitz, 1989)
Adaptation	Behavioral or organizational modifications carried out by an organization to meet the specific needs of another (Brennan et al. 2003)
Conflict	Overall level of disagreement between trading partners (Palmatier et al. 2006)

5.2.2.1. Electronic Data Interchange (EDI)

It is difficult to come up with an exact date for the origin of EDI but most academic and industrial authors agree that it was first introduced in the 1960s (Clarke, 2001; Ramaseshan, 1997). EDI consists of "a computer-to-computer exchange between trading partners of agreed and structured business documents such as purchase orders, invoices, consignment notes, remittance advice and customs documents" (Power and Sohal, 2002). Before its adoption, inter-firm communications were conducted mainly through mail, telephone and fax. EDI was primarily perceived as a way to reduce costs, and then as a means of acquiring a competitive advantage and improving the accuracy of information (Ramaseshan, 1997).

Two dimensions of the buyer-seller relationship, namely *commitment* and *communication and information sharing*, have both been influenced by investments in EDI technology (O'Callaghan et al. 1992). EDI trading partners generally feel fairly committed to long-term relationships and also perceive that they have a privileged long-term relationship with one another (Dupuy and Vlosky, 2000). The buyer's future purchase intentions are influenced by its satisfaction with the seller's use of EDI (MacDonald and Smith, 2004). They also share more information faster (Dupuy and Vlosky, 2000).

In general, the adoption of EDI is viewed as a mutual collaborative decision between buyers and sellers (Ramaseshan, 1997), as both have been known to encourage its adoption (Sriram and Banerjee, 1994) and benefit from such a joint initiative (O'Callaghan et al. 1992). However, the perceived advantages of EDI sometimes entice powerful buyers to force its adoption on their suppliers (Webster, 1995), thereby introducing *conflict* in their relationships. Inducing the *adaptation* of a trading partner so that it will adopt EDI has been done to transfer competitive pressures from the marketplace to suppliers (Reekers and Smithson, 1994). External pressures from trading partners are indeed an important factor explaining the adoption of EDI by SMEs (Iacovou et al. 1995), even more than its perceived benefits (Chwelos et al. 2001). However, since large suppliers can also be forced to adopt EDI (Webster, 1995), low bargaining power may be a stronger explanatory factor than size (Iskandar et al. 2001a). *Power imbalance and interdependence* would therefore better explain EDI adoption, as about a third of suppliers have strongly or very strongly encouraged their buyers to adopt EDI (Sriram and Banerjee, 1994).

5.2.2.2. Bar codes

Bar-coding can also be considered an IOS technology (Vlosky and Wilson, 1994). A bar code consists of a label with alternating black and white lines most often representing a Universal Product Code (UPC) that can be read by an optical scanner (Fiorito et al. 1998). They are used to improve the accuracy of information and data transmission speed (Manthou and Vlachopoulou, 2001) and to encourage *information sharing*. In the retail sector, IOSs such as EDI and UPC bar-coding enable modern logistic strategies like Just-In-Time (JIT) for manufacturers and its Quick Response (QR) equivalent for retailers (Levy et al. 2004; Wilson and Vlosky, 1998).

Although it was introduced commercially later than EDI, in 1974 (Varchaver, 2004), bar-coding's widespread use in the retail sector preceded the use of EDI (Abernathy et al. 2000). One possible reason is that, in order for EDI to function, an accurate product identification method is required for each Stock Keeping Unit (SKU). Bar-coding constitutes such an identification method and therefore enables advanced retail strategies. For example, immediate Point of Sale (POS) data cannot be transmitted via EDI without bar codes (Fiorito et al. 1998), which in turn support a QR system that can reduce lead time by a week or more (Levy et al. 2004).

These benefits of bar-coding have encouraged some buyers to ask their sellers to adopt the technology (Wilson and Vlosky, 1998), which in turn has influenced their relationships. In a study conducted in the retail industry, focusing on wood products (O'Callaghan et al. 1992), it was demonstrated that UPC bar-coding resulted in a poorer-quality buyer-seller relationship in the short term, but later and paradoxically, in a stronger relationship. Additionally, suppliers believe that their own adoption of bar-coding will make buyers somewhat more dependent as they have to rely on them. Sellers also feel that they adapt to bar-coding requests and have made significant investments to satisfy buyers' requirements, whereas the latter feel that the opposite is true. This dichotomy in perception contributes to the fact that suppliers feel that the challenges linked to their *adaptation* are not sufficiently appreciated by buyers (Vlosky and Wilson, 1994). A more recent study (Dupuy and Vlosky, 2000) of a different form of IOS supports these findings: suppliers feel that they give in to their customers' EDI requirements and that they invest a lot of time and money in order to *adapt* their internal processes to accommodate buyers.

5.2.2.3. Internet and extranets

The Internet was created in 1969, but it was only after the introduction of the World Wide Web (the Web) that its utilization grew rapidly. It serves as a backbone for data transmission and promised to aid in the large-scale adoption of EDI by replacing the more costly Value Added Networks (VAN) that were used to exchange documents. It also supported the next waves of IOS such as the Web and extranets as well as more complex forms of electronically mediated processes such like e-procurement and e-marketplaces. A study on Internet use in industrial channels (Boyle, 2001) indicates that Internet use increases *commitment* towards the supplier and that Internet users *communicate* more frequently with suppliers and customers.

Extranets consist of private Web pages that are accessible only to privileged trading partners. An empirical study (Vlosky et al. 2000) found that companies that use extranets exchange a larger quantity and new types of *information* and *communicate* more frequently with extranet partners. They also feel a deeper *commitment* towards their trading partners (Vlosky et al. 2000). Although a certain degree of *adaptation* is required by the trading partners, no use of *power* was perceived. This finding is different from other types of IOS, where *adaptation* often results in some form of *conflict.* It should be noted, though, that extranets are less invasive. They generally consist of a Web interface where information is simply shared with a trading partner rather than integrated with internal systems.

5.2.2.4. E-Procurement

E-procurement systems started to appear around the mid-1990s (Howard et al. 2006). They electronically link buyers' procurement systems with their suppliers (Puschmann and Alt, 2005). Their main benefits are the reduction of operating and searching costs (Dai and Kauffman, 2001).

More transparent information may lead to increased outsourcing, improved procurement processes and more strategic management of certain types of indirect purchases (Croom, 2000), which can completely redefine the nature of buyer-seller relationships in the supply chain and even of the supply chain itself. For example, investing in e-procurement leads to a reduction in the supplier base, thereby making more sales volume available to the remaining suppliers (Stump and Sriram, 1997). Another study has also concluded that the introduction of e-procurement can shake down the supply chain through an iterative process of supplier *adaptation* (Boeck et al. 2006). The suppliers that survive the "shakedown" have a significantly closer relationship with their buyers (Stump and Sriram, 1997).

The existence of a relationship between the use of e-procurement and the buyer-supplier relationship has been quantitatively verified (Carr and Smeltzer, 2002). In their study, e-procurement was defined in terms of automated purchasing systems that electronically link buyers with key suppliers and that could include EDI. It was proven that e-procurement technologies increase the frequency of *communication* between trading partners. It was less clear, though, whether this increased frequency also meant an increased richness of the communication content. Equally interesting was the fact that the adoption of e-procurement was not related to *trust* between the trading partners.

5.2.2.5. E-Marketplaces

Introduced at the end of the 1990s (Puschmann and Alt, 2005), e-marketplaces are digital intermediaries in which members can participate in buying and selling activities (Dai and Kauffman, 2001). They can also be used in conjunction with an e-procurement strategy (Boeck et al. 2006). E-marketplaces attempted to compensate for some of the shortcomings of earlier IOSs. For example, for a supplier to *adapt* to its buyers' e-procurement systems, it had to electronically link to many proprietary IOSs, which was very costly.

E-marketplaces are similar to other IOSs in the sense that they can change the inter-organizational processes between buyers and sellers and thus reshape buyer-supplier relationships (Murtaza et al. 2004). For example, the use of e-marketplaces can contribute to building *trust* (Ratnasingam, 2005). They can also improve coordination activities and increase the speed of *information sharing* (Murtaza et al. 2004). It was also found that e-marketplaces are associated with a reduction of the supplier base and a deepening of the relationship with the remaining suppliers (White and Daniel, 2004). Again, the adoption of e-marketplaces is often encouraged by buyers, especially when SME suppliers are involved (Boeck et al. 2006); sometimes the latter feel their margins being squeezed and choose to offer some form of resistance (Gulledge, 2002), thus fostering *conflict*.

However, e-marketplaces differ from other IOSs in certain distinctive characteristics. Contrary to other forms of IOS, which are based on one-to-one or one-to-many relationships, e-marketplaces are based on many-to-many relationships (Murtaza et al. 2004). This fundamental difference from other forms of IOS enables new electronic relationships to emerge among buyers, who may team up to form consortiums (Gulledge, 2002). They also differ in that they can be more collaborative in nature than e-procurement (Gulledge, 2002) and other IOSs because the electronic interactions between buyers and suppliers can go beyond basic buying and selling to include *cooperation* (Howard et al. 2006; Lancastre and Lages, 2006). Certain e-marketplaces are more appropriate to specific types of buyer-supplier relationships (Skjott-Larsen et al. 2003), which would explain the adoption of transactional or cooperative e-marketplaces (Markus and Christiaanse, 2003). In a purchasing context, it is therefore suggested that the fit between the purchase situation and the e-marketplace be managed to maximize *relationship value* (Hartmann et al. 2002).

5.3. Methodology

5.3.1. Research Design

This paper's objective is to discover the link between RFID and buyer-seller relationships in one supply chain in the retail industry. The study was exploratory in nature because RFID research in a business setting is still in its infancy (Sellitto et al. 2007). Consequently, it was guided by a general intent to seek an understanding of the phenomenon rather than by a specific research proposition (Yin, 2003).

The research design relied on two exploratory research methods: carrying out a multiple case study while building on the grounded theory approach. The case study method allowed us to set and limit the scope of the research design to a specific group of companies and to gain an in-depth understanding of the phenomenon under investigation. It also provided guidelines and a framework (Eisenhardt, 1989; Yin, 2003). The grounded theory approach was used as a guiding philosophy of keeping an open mind to allow for the discovery of unbiased new concepts revealed by emerging patterns in the data itself (Glaser and Strauss, 1967). Special care must be taken when combining the two methods (Fernández et al. 2002) since the case study's more structured approach can limit the theory-generating approach of grounded theory. Using both methods seems particularly appropriate when exploring an emerging phenomenon such as RFID adoption and investigating complex behavioral issues related to buyer-seller relationships. Other authors have also combined both methods (Correia and Wilson, 1997; Lehmann, 2000) and the overall approach has already been operationalized in several steps, as outlined by (Eisenhardt, 1989).

5.3.1.1. Firms involved in the study

The field study was conducted in one retail supply chain. Ten companies were involved: three manufacturers, referred to respectively as "Bottler A," "Bottler B," and "Bottler C"; one first-level distributor (called here "Distributor 1") through which all products must transit; three second-level distributors, referred to respectively as "Distributor 2A," "Distributor 2B" and "Distributor 2C," who distribute to the three retailers called "Retailer A," "Retailer B" and "Retailer C." The buyer-seller relationships link the buyer-seller dyads together. The Bottlers are linked to Distributor 1; Distributor 1 is both a customer of the Bottlers and a supplier to the level-2 Distributors; and these Distributors are linked to the Retailers. These supply chain members are responsible for a bottled beverage destined for human consumption. Approximately 180 million units flow through these companies each year.

5.3.1.2. Researchers' roles

The researchers played the role of participant-observers since they were actively involved not only in the different data collection activities but also in the formulation of the technological scenarios and the organization and conducting of focus groups. The participant-observer approach, which has been used successfully in studies of inter-organizational relationships (Nordin, 2006) and in the retail industry (Geiger, 2007), provides several advantages which are otherwise difficult to attain (Creswell, 2003; Yin, 2003). In particular, it allowed the researchers to gain access to sensitive and confidential internal reports, strategic documents and detailed written operational procedures. It also provided a unique understanding of the supply chain which only someone "from the inside" can acquire after a certain immersion. For example, the researchers required several meetings to understand the companies' idiosyncratic expressions and references, which in a sense constituted a unique language for which a short dictionary was created to facilitate later interactions during the study. This approach also led to additional insights and understanding that contributed to a much better interpretation of the field data.

5.3.2. Data Collection

The data collected consisted of structured, semi-structured and non-structured interviews with 52 individuals from 10 functional teams; focus groups with several managers of the same company and with several companies of the supply chain; on-site visits of the factory, warehouse and retail locations; multiple on-site observations for process mapping and time-and-motion studies also involving videos of interviews and of work being performed; personal memos and field notes; internal reports and other documents such as debriefing notes. The research followed the steps outlined in earlier work to determine the impact of RFID in a supply chain (Lefebvre et al. 2006). This was done to assist in data collection and adds to the validity of the construct (Yin, 2003). The process approach, which is central to this tool, has already been used in previous RFID studies (Lefebvre et al. 2005a; Subirana et al. 2003) and is consistent with the study of buyer-seller relationships (Izquierdo and Cillán, 2004).

Reliability of the data was ensured by having several researchers collect data individually and in groups. A total of ten researchers were involved at one time or another during the study. After each event, personal notes were written and compared and consensus was reached. Both qualitative and quantitative data were collected and triangulated through several methods. The data collection process was highly iterative and lasted until the information derived became redundant and saturation was reached (Glaser and Strauss, 1967). This lengthy process of moving back and forth between data collection, coding and analysis spanned three years from spring 2004 to 2007.

5.3.3. Data Coding and Analysis

Field notes were individually transcribed and coded as soon as possible after being taken. Coding was compared among the researchers and, once adequate, was centrally stored with the raw data. For the purpose of this specific study, the researchers extracted all data pertaining to buyer-seller relationships. This was done by extracting from the raw and coded data all information that contained the following elements:

1. Words and codes relating to “customer”
2. Words and codes relating to “supplier”
3. All aspects pertaining to trading partners
4. All aspects pertaining to their relationships with one another

This information was then clustered into key issues or categories in a manner inspired by studies using similar methods in similar settings (Geiger, 2007; Lee, 2001). The analysis consisted of within- and between-case explanatory analysis (Miles and Huberman, 1994). The resulting categories indicate how RFID is linked to buyer-seller relationships. They were agreed upon by the senior researchers, who were present throughout the entire study, and are supported by both field data and theoretical generalization (Hillebrand et al. 2001). Respondent quotes, examples from observation and anecdotes are provided to support the categories that are presented in the findings. In the discussion section of this paper, a final analysis is undertaken to clarify how these categories influence the key buyer-seller relationship dimensions presented in the literature review.

5.3.4. The RFID Scenario Retained

The technological scenario retained for the proposed RFID infrastructure was validated with senior RFID specialists. Its technical feasibility was tested and a simulation with real-life data was conducted using a working laboratory Proof of Concept (Bendavid et al. 2006).

The study used Alien M tags, which are passive Write-Many Read-Many (WMRM) EPC Class 1 Generation 2 RFID labels that operate at 915 MHz and are commonly referred to as Gen2 UHF tags. The information contained within the tag is the product description, lot number, quantity in pallet, order number, case identification and pallet identification when appropriate. These labels can be affixed to any packaging unit, such as a bottle, a case or a pallet. The readers used are Symbol XR400 attached to AN400 High Performance antennas, Symbol MC9060R handheld readers and Symbol RD5000 mobile readers positioned at strategic locations throughout the supply chain, such as the entry and exit points, as well as on the forklifts. The trucks can interrogate the contents of their shipments and transmit this information in real time using a reader connected to a wireless network. The study assumes perfect readability of the RFID tags and an ideal transmission environment where radio interference is at a minimum. It also assumes perfect signal propagation in the near and far field, thus making dual tagging unnecessary (Harmon, 2006). This implies that the antenna can scan an item when it is packaged into cases and pallets. By making this assumption, we are eliminating the problem of "tag shadowing" (Maloni and DeWolf, 2006) which is created when multiple tags are in very close proximity. The researchers and the participants believed that temporary technical limitations on RFID should not limit the findings because RFID technology is speedily evolving towards improved read rates in difficult conditions. For example, UHF tags can now be used for near-field scanning through liquids, a feat that was not possible only a few months ago (Desmons, 2006).

5.4. Results and Discussion

5.4.1. Current Processes in the Retail Supply Chain

Figure 5.1 illustrates the usual flow of the products among supply chain members (as indicated on the horizontal axis) under normal conditions. These flows were mapped by literally following a product though its entire supply chain and by interviewing the employees who handle the products and their direct supervisors. The higher-level managers also validated these flows.

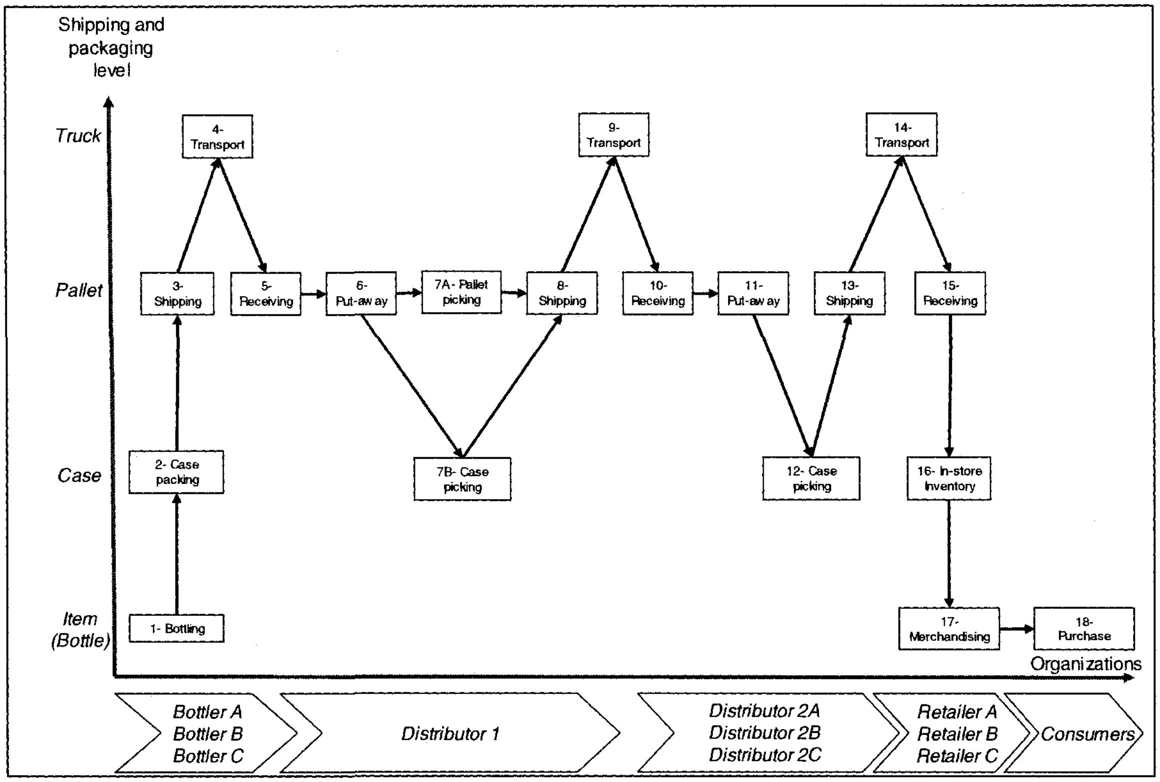

Figure 5.1: The RFID Supply Chain Flow model depicts the physical flows in the retail supply chain

Figure 5.1 also takes into account the level of granularity (as illustrated in the vertical axis) of the shipping and packaging levels that must be taken into account in the analysis. In the group of companies studied, the lowest level of granularity is the item level or bottle.

The numbered boxes in the figure represent the major supply chain processes through which most products travel to reach the final customer, the Consumer. The processes travel up and down the vertical axis as the product changes shipping and packaging levels. The supply chain process starts at the Bottlers, where the components of the product are assembled as described below:

5.4.1.1. Bottler processes

On a fully automated conveyor belt, the product is assembled when the beverage is poured into glass bottles. A label with a Universal Product Code (UPC) bar code for identification purposes is then glued to the bottle (referred to as process "1- Bottling" in the lower left-hand corner of Figure 5.1). At the end of the conveyor belt, the products are packaged in corrugated boxes that contain bar codes called Shipping Container Codes (SCC) for identification purposes (process "2- Case packing"). These cases are then bundled onto pallets to facilitate their handling. Next, License Plate (LP) bar codes are affixed to the pallets. It should be noted that UPCs and SCCs and LPs serve the same general purpose but at different tracking levels. The pallets of identical items are briefly stored in the staging area near the shipping docks until they are moved into the trucks (process "3- Shipping"). The shipment leaves the Bottlers and moves on to Distributor 1 (process "4- Transport").

5.4.1.2. Distributor 1 processes

The shipment is unloaded in the staging area near the receiving docks where the nature and quantities of the packages are verified manually and by scanning the LPs and the SCCs (process "5- Receiving"). A forklift driver then moves the pallet to its appropriate storage rack and confirms the location and pallet by scanning both (process "6- Put-away"). The next step depends upon the order that has been received from the Retailer. When the Retailer requests a pallet of a single type of product, the forklift driver simply removes the pallet while rescanning both the LP and the storage bin to confirm that the right product has been chosen (process "7A- Pallet picking"). Normally, if more than one pallet of the product is available, the forklift driver should pick the first one that was warehoused rather than the closest one available in the usual inventory First-In, First-Out (FIFO) mode. If, however, the retailers request different types of products, then a clerk must walk the aisles to pick individual cases, thus breaking down the pallet into its lower handling units. At this point, the pallet's LP is no longer valid as the pallet has lost its integrity. The clerk scans each case's SCC to validate that the right product has been picked. When all cases have been picked, a new pallet is now formed with mixed cases and a new LP is printed and affixed to the "mixed pallet" (process "7B- Case picking"). Pallets of various products are deposited in the staging area near the shipping docks. The pallets' LPs are scanned as they enter the truck in order to confirm their identification. Mixed pallets undergo the additional step of being manually verified by a controller beforehand (process "8- Shipping"). The shipment leaves Distributor 1 by truck and is tracked through GPS (Global Positioning System) until it arrives at the second-level Distributors (process "9- Transport").

5.4.1.3. Distributor 2 processes

The pallets are unloaded from the truck and quantities are manually verified and a handwritten paper-based report is generated (process "10- Receiving"). The pallet is taken from the staging area and deposited in the warehouse. The clerk scans the put-away label and enters the storage rack information into the Warehouse Management System (WMS) (process "11- Put-away"). Based on the order to fulfill, the WMS informs the clerk where to find the case to pick through a voice interface. Picking is done in FIFO mode and performed with the equivalent of a big shopping cart. The process was described during the on-site interviews as "doing the groceries for the grocery stores"; in fact, the purchase order presents the disparities of a "shopping list" (process "12- Case picking"). At this point, the odd shapes of various items on the pallet make its general form less rectangular and more incongruent. It is nearly impossible to determine with the naked eye the content at the center of the heavily shrink-wrapped pallet as it waits to enter the truck (process “13- Shipping”). The shipment leaves the Distributor and may make several stops and travel several hundred kilometers before reaching its destination at the different Retailers (process “14- Transport”).

5.4.1.4. Retailer processes

Once the shipment arrives at the Retailer, it is unbundled to the case level in order to manually verify that its content matches with the purchase order. This is very time-consuming due to disparate items (process “15- Receiving”). The products are then kept in the back-store (process “16- In-store inventory”) until a clerk is available to move it to the front-store as shelf space is made available. The product finally returns to its initial item level as it is displayed (process “17- Merchandising”) for the Consumers who may decide to buy the item. The UPC is scanned during checkout (process “18- Purchase”).

This model was developed in order to provide a visual representation of relevant RFID information in a supply chain environment. The following section presents our findings on the influence of RFID on buyer-seller relationships in a supply chain environment, referring to the above figure and its description as background.

5.4.2. Key Issues

The adoption of RFID raises a number of key issues that affect or are affected by buyer-seller relationships. These are discussed in the following paragraphs.

5.4.2.1. RFID benefits travel downstream to customers as externalities

Once a product is tagged, it can be read at any later time. Therefore, later processes also benefit from the RFID tag as it travels down the supply chain. If a tag is affixed as illustrated in Figure 5.2 during a manual Slap & Ship operation by the Bottler (process "3- Shipping"), then the same tag can also be read by Distributors 2 when the pallet is placed in storage (process "11- Put-away"). The RFID-enabled process is more efficient because it reduces errors caused by manual verification. The second-level Distributors benefit from information within RFID tags whose costs were covered by the Bottlers. The benefits thus diffuse to subsequent processes after tagging is performed until, as will be explained in the next paragraph, the shipping and packaging level declines below the level at which the tagging was performed. In the current illustration, where tagging is performed at process "3-Shipping," the benefits cease to propagate through the supply chain when either process "7B- Case picking" or process "12- Case picking" is performed.

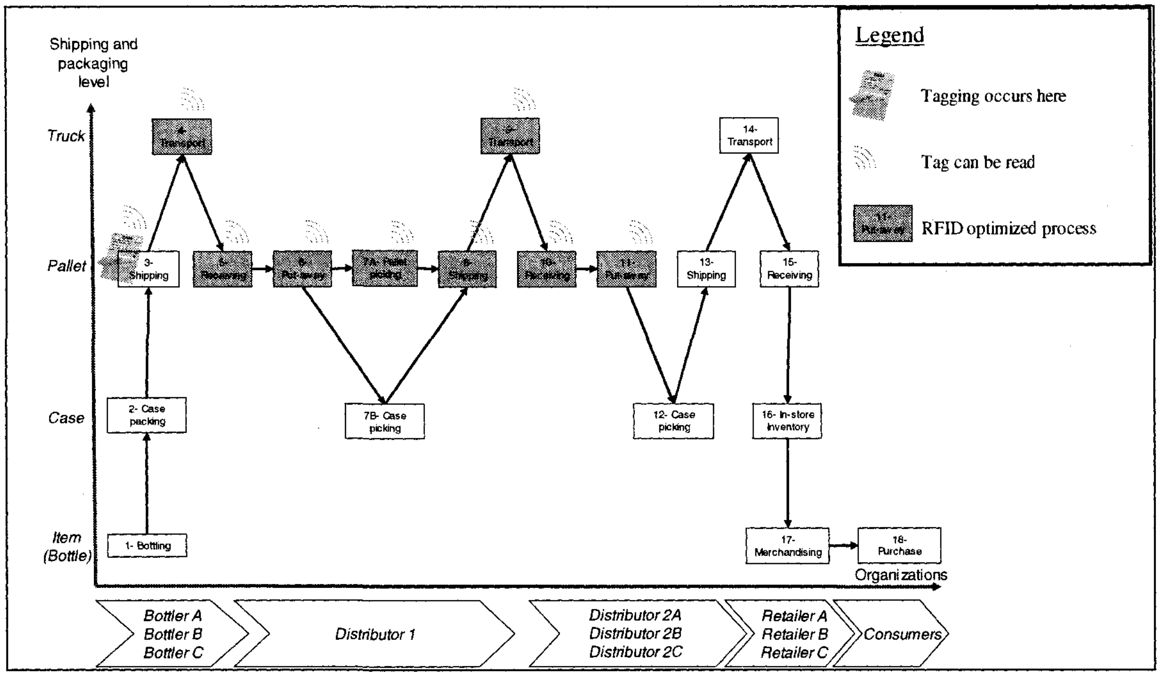

Figure 5.2 : Propagation of RFID benefits when tagging occurs at process "3- Shipping" and if process "7A- Pallet picking" is performed instead of process "7B- Case picking"

5.4.2.2. RFID benefits can also travel upstream to suppliers with an EPC network

This second issue is complementary to the first issue, which stated that benefits travel downstream and can only be realized if RFID data resides in a centralized location to which all supply chain members have access. This is the case when using the Electronic Product Code (EPC) network rather than having the data reside exclusively in the tag itself: RFID-related information can then travel anywhere in the supply chain from the point where the tag is scanned and benefits derived from this shared information can be obtained throughout the supply chain. For example, when an item is sold at the Retailer (process "18- Purchase"), the centralized database is updated and the Bottlers can instantaneously be told to replenish the store. Receiving the information directly from the Retailer and at the exact moment when it occurs instead of letting it travel through several layers of companies has the advantage of increasing information flow, which can reduce the "bullwhip effect" (Paik and Bagchi, 2007) whose ripple effects on demand can cause inefficient work orders (Disney et al. 2004) for the Bottlers. Currently, the Bottlers produce to capacity and have no direct view of consumer demands. Another example raised by participants in the field was discussed at length. The supplier would benefit from the visibility of its own shipment when it is received at the customer's receiving dock. The Bottlers have unsettled claims with Distributor 1 because of shrinkage. Shrinkage occurs when quantities decrease between two specific control points. It may be due to breakage, misplaced items, poor bookkeeping or even theft (Levy et al. 2004). If the merchandise is scanned as it leaves their location and rescanned once it arrives at Distributor 1, the two quantities can be compared and reconciled instantaneously. This reduces shrinkage and improves cash flows by allowing billing to be done more quickly.

5.4.2.3. The tagging level influences the supply chain benefits

What makes an RFID project different from other IOS initiatives is that the information is physically linked to the products. As such, when products aggregate or break down, the information tied to an item can be increased or lost. If tag placement occurs at the case level, such as during process "2- Case packing" or process "7B- Case picking," then tracking can still occur at the pallet and truck level because the case entity which was tagged still exists. It is simply aggregated into a more encompassing unit. Conversely, when tracking is performed at the pallet level by affixing a tag at process "3- Shipping," then tracking is lost if process "7B- Case picking" is performed because the pallet is broken down into its individual cases (Figure 5.2). Since the tag was on the pallet and the pallet is now broken down and thus no longer exists, the tracking is lost.

Empirical evidence supports this statement. In fact, participants in the focus groups identified this issue when discussing the benefits of managing inventory levels at process "16- In-store inventory." A vice-president mentioned that if tracking was done only at the case level, inventories would be inaccurate as soon as the case was opened. Sometimes only half of the bottles are placed on the shelf and the box returns to the backroom half full. The tag on the case would not let clerks know how many bottles were removed and they might assume it is still full. Tagging at the item level would eliminate this problem. Additional empirical evidence to this effect comes from the simulation of the technological scenarios. The initial scenario envisioned tagging at the pallet level in the Bottlers' facilities during process "3- Shipping." However, Distributor 1 experiences most RFID benefits at the case level during process "7B- Case picking," which is one level lower than in the initial scenario. Because tagging at process "3- Shipping" provided no benefits to process "7B- Case picking," it became clear that the level of granularity for tagging influences the benefits.

5.4.2.4. There is a strong tendency to push tagging upstream

Since later processes benefit from the RFID tag that has been affixed, it is logical to push the tagging back as early as possible. Indeed, it would not make much sense to choose to tag the products during process "7A- Pallet picking" in order to benefit from RFID at process "8- Shipping" when the same tag could be affixed at the same shipping and packaging level during process "5- Receiving" and thus also benefit process "6- Put-away." It would involve the same tag and the same readers on the forklifts and dock doors. As such, no additional hardware investment is necessary in order to benefit from RFID in these earlier processes.

A lot of time and effort was spent in the field study to optimize case picking. For Distributors 2A, 2B and 2C to benefit from RFID during process "12- Case picking," only two tagging options exist: Distributor 1 must affix the tags during process "7B- Case picking" or the Bottlers must affix them during process "2- Case packing" (Figure 5.3). In both cases, the supplier or the supplier's supplier must tag the case for the benefit of the level-2 Distributors. This demonstrates how organizations will tend to push the tagging to their suppliers to maximize their own RFID benefits. The same occurs at the pallet level. During the field study, it was demonstrated that Distributor 1 would have a more efficient process during process "5- Receiving" if the pallets came in already tagged since less manipulation would be necessary to verify quantities and content at the receiving dock: this would therefore translate into fewer employees required at the dock. However, for Distributor 1 to benefit from RFID during this process, the tagging must be performed before the pallets arrive. This implies that tagging must be performed by the Bottler during process "3- Shipping" or by the transport company during process "4- Transport."

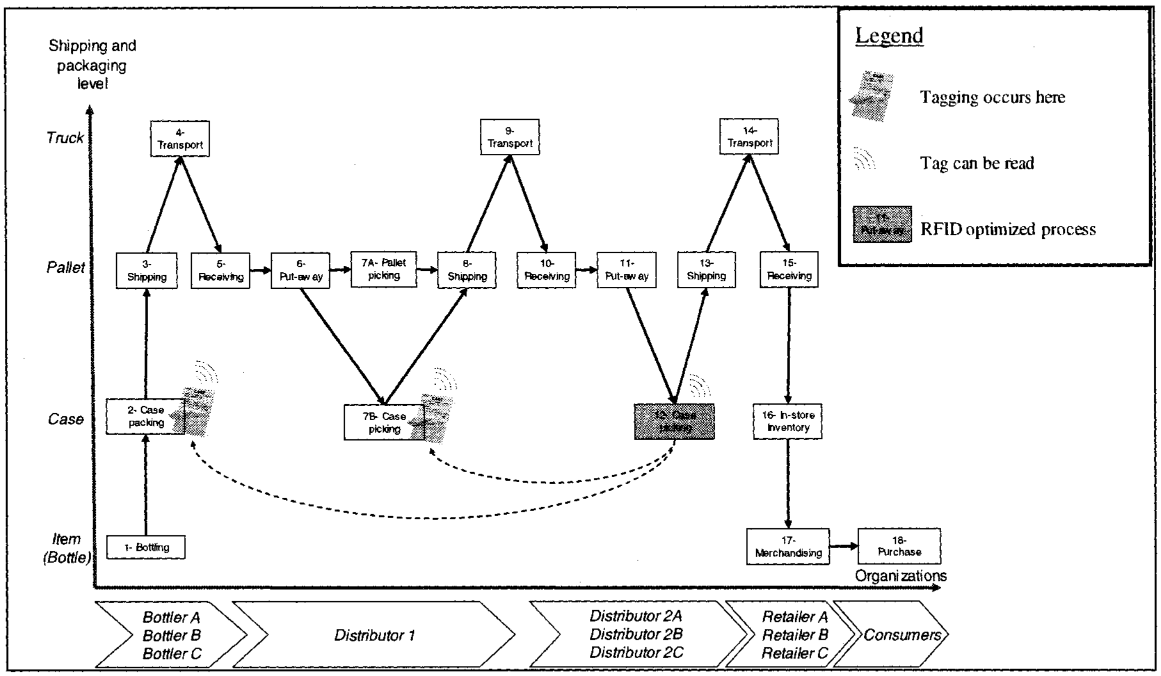

Figure 5.3 : In order for second-level Distributors to optimize process "12- Case picking," tagging must occur either at Distributor 1 or at the Bottlers.

5.4.2.5. There is a tendency to push tagging back to the Bottlers

Another factor besides process optimization contributes to pushing the tagging back to the Bottlers. Distributor 1 indicated that if it were to attach the tags itself, the process would be manual because the conveyor belt is only at the Bottler's location. Manual intervention proved to be error-prone on more than one occasion during the study. In fact, reducing manual intervention is an important RFID benefit for the respondents. They believe it is up to the Bottler to program and affix the tags on the products while they are on the automated assembly line in order to reduce the introduction of errors in the supply chain's data. A manager at Distributor 1 said: *"The Bottlers should put on the tag, because we don't want to introduce errors, which can be costly. The other day, 40-ounce bottles sold as 26-ounce bottles because of errors between the SCC on the box and the UPC on the bottle."*

Two other potential factors were initially thought to favor having the Bottlers tag the products. However, validating these factors with the respondents revealed that this was not the case. Specifically, it was first mentioned to the researchers that another advantage of pushing the tagging to the Bottlers was to unload the cost of the RFID tag onto other supply chain members. When asked if this was an advantage for them, respondents answered that it was not because "*our supplier will just end up charging it back to us one way or another.*" Secondly, our model indicates that more benefits are gained if tagging occurs at lower levels (Figure 5.2). As such, tagging at the item level should provide benefits for all the processes in the supply chain. Because this can only be performed by the Bottlers at process "1- Bottling," Bottlers would eventually be pressured by all the other supply chain companies. However, this was not the case in our study. Both Distributor 1 and the level-2 Distributors were concerned with optimizing processes at the case level, not the item level. Indeed, the model shows that these companies do not handle the goods at this level. As the cost of tags goes down, perhaps the Retailers will demand that the Bottlers tag their items. Item tagging implies twelve times more tags than case tagging because each case contains twelve bottles. According to our study, the cost of the RFID system would outweigh the benefits.

5.4.2.6. The efficiency of inter-organizational processes can be improved

Many observed inefficiencies in the inter-organizational processes could be resolved by RFID. For example, shrinkage was recognized as a major irritant throughout the entire supply chain studied. Much shrinkage occurs between the time a product was accounted for at shipping and its arrival at the customer's receiving dock. However, the exact cause and location of shrinkage cannot be proven, and so the supplier has the burden of proof and regularly absorbs the cost of missing products. This constitutes a major irritant for all members of the supply chain. Based on our fieldwork, RFID has the potential to provide the necessary proof to indicate when the shrinkage occurred. By removing this uncertainty, unfounded accusations, feelings of being manipulated and arguments can be reduced, consequently improving the relationships between customer and supplier. Reducing shrinkage is seen as the major RFID benefit for Distributor 1: *"the day when you'll be able to validate the content of a pallet at the case level during shipment to a customer is the day we will go forward with the RFID project."*

Numerous additional inter-organization processes can also be improved with RFID. The Retailer has been known to return truckloads of shipments although only a single pallet was missing or the shipment arrived only five minutes late. These problems, which strain the relationship between organizations *"are the worst and are frustrating,"* as mentioned by one dock worker. Errors due to an inefficient verification process can be avoided with RFID.

5.4.2.7. RFID cannot compensate for lack of trust, which is an a priori condition

Some level of mistrust was present throughout the entire supply chain as exemplified by the following comments: *"It's funny how claims are more frequent on higher-ticket items"* or *"Our customers are trying to make some money off of us (...) by pushing unfounded claims, but if they receive a case that wasn't on their order then we won't hear about it (because they will keep it)."*

When the benefits the proposed RFID solution could procure are presented, the respondents quickly and often tried to see how the system could potentially be manipulated by their trading partners. Comments such as *"Can the system be tricked with cell phones, for example?", "The supplier could decide to put on two tags per case in order to double-charge us," or "They could close the reader when they receive certain products to avoid being billed for them"* clearly indicate a lack of trust. An RFID system will never be full-proof and cannot compensate for a lack of trust.

5.4.2.8. RFID is a Supply Chain Management IOS

The influence of RFID goes beyond the boundaries of any specific organization as information sharing can impact every member of the supply chain. RFID represents an IOS technology that piggybacks on products as they travel through the entire supply chain. As such, it has the potential to be a powerful SCM technology. This was emphasized by one senior executive from Distributor 1: *"This RFID project is truly the first initiative to move throughout our whole supply chain and impact our customers as well as our suppliers."*

Aligning the supply chain to a common project is therefore seen as a prerequisite for implementing RFID. A high-level director mentioned that gaining buy-in from suppliers is essential: *"We need to be able to demonstrate to our suppliers what their benefits will be for them to support our RFID initiative."* In another company (Distributor 2A), alignment among the supply chain members is believed to require strong leadership that a powerful firm could provide.

5.5. Conclusion

The results presented in this paper should be interpreted in the light of certain limitations. First, the observer's role is intermingled in this field research with that of the participant. This has the potential risk of influencing the participants by advocating a particular position, the risk of supporting a group of individuals when neutrality is required, and the risk of the participant role's requiring too much attention for good observations to take place (Yin, 2003). The researchers were aware of those potential pitfalls and tried to remain as neutral as possible. Second, the technological scenario is based on current improvement trends in the RFID industry. More specifically, perfect read rates are an optimistic extrapolation of today's state-of-the art technology but this is seen as a temporary technical obstacle. Third, the study was conducted in a single supply chain in the retail industry, which allowed us to gain in-depth knowledge of a complex phenomenon. Future research could attempt to validate these findings in other supply chains in other industries. Moreover, future studies could delve deeper into this phenomenon. For example, a longitudinal study of an RFID initiative implemented in a supply chain could indicate whether relationship quality diminishes in the short term only to increase later, as has been found to be the case with bar code and EDI implementations. It would also be interesting to identify the RFID adoption antecedents and the contributing factors that make trading partners want to either collaborate or resist.

The interplay between RFID and buyer-seller relationships in a supply chain is an intricate phenomenon. Based on the empirical evidence from the ten firms involved in the field study, the following summary observations can be made:

Communication/information sharing: Access to shared information is at the heart of an RFID initiative. The information related to a specific product is shared among trading partners as the product travels downstream through the supply chain. Information can also travel upstream if the chosen technological architecture supports it. However, the level of information sharing (who can access specific information) depends on other characteristics of the relationships between supply chain members.

Cooperation: The desire to make a shared RFID supply chain project a reality clearly necessitates a deep desire for cooperation from all members of the supply chain. Once this technological infrastructure is in place, it should also facilitate supply chain initiatives, thereby enabling the supply chain to work as a more collaborative team.

Trust: An RFID system has the potential to reduce a major part of the shrinkage that had caused a lack of trust among some of the organizations in the study. By acting as a constant verification system, it provides accountability for quality and volumes of shipments. Shrinkage will tend to diminish, thus making the trading partners more trustworthy. However, an initial inherent level of trust that partners will not try to bypass the RFID system is necessary if it is to be effective.

Commitment: Implementing the RFID system will initially necessitate a considerable investment. A portion of this investment will represents sunk costs that will not be recovered should the relationship end. However, once RFID is implemented, the relationship should be more profitable. The natural tendency would be to build on the relationship as long as possible in order to recoup the investments and increase profits.

Relationship value: Additional information will be accessible to members of the supply chain who use RFID together. Shrinkage in the supply chain will be reduced. New opportunities for collaboration will increase the value provided by customers and suppliers who use RFID. The relationships with trading partners who use RFID will therefore be increased when compared to those with partners who do not use the technology.

Power imbalance and interdependence: Both suppliers and buyers feel that an RFID initiative will give the other party more power. Suppliers feel that an investment and the associated sunk costs may lock them in vis-à-vis the buyers. Buyers feel that suppliers who use RFID technology will give them increased relationship value, which will place them in a more competitive position.

Adaptation: Some organizations that are lured by the benefits that RFID promises may use their power to influence their trading partners to adapt to the new RFID requirements. As RFID technology improves, there will be a trend to push the technology further back and further down in the supply chain. As this happens, the company in the role of manufacturer is likely to be increasingly pressured by its trading partners to adopt RFID.

Conflict: The ten organizations in this study are aware of potential conflicts related to RFID adoption and use positive reinforcements to get their trading partners to join the RFID initiative. If the trading partner does not want to go in this direction, pressure may eventually be applied. The situation could potentially create conflict in the buyer-seller relationship.

Some deep practical implications arise out of these findings. Wal-Mart's initiative acted as the flagship for RFID as an IOS project but now other supply chains are currently evaluating or going forward with similar RFID initiatives. It is important that these companies be aware of the strategic role of supplier-buyer relationships as both crucial antecedents that shape RFID infrastructure and a consequence of RFID implementation. Furthermore, the continual improvement of RFID technology will tend to strain relationships among supply chain members since the use of power to urge adaptation may lead to conflict. RFID technology brings business partners one step closer to the vision of aligning their supply chain and raising the competition to the level of "chain versus chain," thus moving closer to acquiring a collaborative advantage. For researchers, the results point to the importance of considering the different layers of the supply chain when investigating collaborative technologies such as RFID, relationships between business partners, or competitive positioning. This is particularly interesting for academic fields such as supply chain management, industrial marketing and diffusion of innovation research.

CHAPITRE 6. TECHNOLOGICAL REQUIREMENTS AND DERIVED BENEFITS FROM RFID ENABLED RECEIVING IN A SUPPLY CHAIN

6.1. Introduction

RFID enabled automated receiving optimizes the handoff of products between supplier and client. It consists of receiving products at a manufacturing facility, a distribution center's warehouse or a retail store without manually scanning or verifying the merchandise (O'Connor, 2006). Although current state of the art receiving systems are highly optimized by using barcoding and wireless communications to a central computer, the process can still sometimes be error-prone and time-consuming because of human intervention.

Few studies have been conducted on the receiving process itself (McGinnis, 2007) and even fewer on RFID enabled automated receiving, despite the high profile mandates in this area. In fact, there is a lack of documented results and no common ground for comparing technological RFID scenarios. Furthermore, benefits and the measures used to compare RFID applications differ from study to study and the scope of their benefits has not yet been fully uncovered. The goal of this chapter will be twofold in order to facilitate the adoption of RFID technology in the context of automated receiving: firstly, to present the different technological infrastructures for the RFID enabled automated receiving application in six different organisations and secondly, to develop a more comprehensive list of benefits that can be used to measure the usefulness of such RFID applications.

This chapter focuses on the implementation of RFID enabled automated receiving, which has been identified as one of the quickest profitable SCM (Supply Chain Management) RFID applications. The following section (section 6.2) briefly outlines the technological and non-technological issues related to RFID enabled receiving while section 6.3 offers some information about the detailed field research carried out in six organisations. The next section (section 6.4) compares the different possible configurations of the application applied to real life environments, their associated benefits and implications. Finally, section 6.5 concludes the chapter with by highlighting how the application can contribute to building a collaborative advantage in the supply chain.

6.2. Background

6.2.1. Technological issues

The exponential growth in interest that RFID technology has recently gathered is without a doubt attributable to the highly mediatised compliance mandates from large organisations like Wal-Mart and the US Department of Defence. The objective of these innovative organisations and other early adopters like Marks and Spencer, Tesco and Metro is to use passive UHF (Ultra High Frequency) radio frequency identification for the purpose of optimizing their supply chain. UHF RFID technology, which is regulated under ISO/IEC 18000-6 and operates in the 860-960 MHz range, has the characteristic over more established Low Frequency (LF) and High Frequency (HF) RFID applications of using far field backscatter communications rather than near-field inductive coupling. The advantage of ISO/IEC 18000-6 and its improved ISO/IEC 18000-6C, commonly referred to as “Gen 2”, is that it uses less expensive tags which are able to communicate more quickly, at a greater distance with better anti-collision protocols. These characteristics therefore enable companies to identify and track many fast moving products through their supply chain more economically.

Additionally, the Electronic Product Code (EPC) network developed by the Auto-ID Center and managed by GS1 facilitates real-time information sharing between companies belonging to the same supply chain. A supply chain is defined as a group of companies that collaborate together in an effort to bring a product, service or information from the initial supplier to the final customer. Collaboration among companies that belong to the same supply chain is part of the strategic vision of having their network gain a collaborative advantage by working as a team.

6.2.2. Non-technological issues

Innovative firms that have started to use RFID-enabled automated receiving have measured and communicated tangible benefits. For example, Paramount Farms a producer of pistachio nuts receives 425 loads of nuts per day (Violino, 2004). It has implemented an RFID system to improve the receiving process of its trailers by affixing a passive 915 MHz tag on each of them. The RFID receiving system automatically gathers the following information: information about the trailer (tare weight, license plate number, owner information), information about its contents (the name of the farmer and the ranch, the location the specific field where the pistachio nuts were harvested, the method used to harvest the nuts, the merchandise's weight automatically retrieved from the scale house) and information about the receiving process (a date and time stamp of when the shipment was received). Paramount Farms indicates that the automated process speeds data entry and ensures accuracy. Data acquisition has gone from 2 minutes to instantaneous and transaction time required to initiate a new load has been reduced by 60%. The faster throughput of the trailers at the receiving station also signifies a better utilization of assets. This has in turn reduced leased trailer usage by 30% and allowed Paramount Farms to cancel plans to build a new scale house. At the warehouse level, RFID can potentially redesign the processes (Lefebvre et al. 2006) and create benefits like those observed during a receiving pilot at a Canadian Staples location. RFID has reduced the processing time during receiving from 5.36 minutes to 2.65 minutes (O'Connor, 2006) and. At the store level, the Staples pilot has reduced the processing time from 17.75 minutes to 2.70 minutes and reduced the number of orders that were delayed thus ensuring that items were available to be sold on time. RFID can thus assist Just-in-Time ordering (Alan D. Smith, 2005). When combining automated receiving data with retail floor data and POS (Point of Sales) data, automatic replenishment can occur (Roberti, 2005) which can reduce out of stocks by 30% for products selling between 0.1 and 15 units per day (Hardgrave et al. 2006). Similar results are provided by the German grocer Rewe who indicates a 80% reduction in the time required to match deliveries with orders (Wessel, 2007). RFID has the potential to transform the store receiving process which is often manual (Peter Jones and Colin Clarke-Hill et al. 2005) while at the same time improving the quality of information (Sellitto et al. 2007).

The retail industry has quickly identified RFID as having the potential to improve collaboration in its supply chain (Peter Jones et al. 2004). It has also indicated that automated receiving as one of the RFID supply chain applications can generate a quick return on investment (ROI) (Roberti, 2007). In 2005, at least 140 Wal-Mart stores used automated receiving (Collins, 2005). In 2007, over a 1000 Wal-Mart locations used RFID with plans to continue increasing the number of distribution centers and stores that use RFID automated receiving (Johnson, 2007). Some concerns have however been raised about the added-value of RFID-enabled receiving. Many potential adopters of the application therefore see it as having mostly incremental benefits especially when their receiving process is already highly efficient.

6.3. Methodology

As part of a broader research program on RFID applications and deployment within supply chains (SC), special emphasis is placed here on the RFID-enabled receiving process which has been investigated in a detailed field research involving six very different organisations (Table 6.1). These organisations represent different types of SC players, operating in either closed or open loop networks and in different environments. The level of granularity needed for RFID tags also differ from the pallet to the item.

Table 6.1 : The organisations that participated to the field research

Organisations	SC Level	Environment	Network	Volume	Unit level
M1	Manufacturer	Assembly plant	Open loop	Low	Item
DC1	Distribution center	Warehouse	Open loop	High	Pallet
DC2	Distribution center	Warehouse	Open loop	Very High	Pallet
DC3	Distribution center	Warehouse	Closed loop	Medium	Pallet
DC4	Distribution center	Outdoor storage area	Open loop	Low	Item
R1	Retailer	Store	Closed loop	Medium	Pallet, case

Data collection methods in the six organisations included direct observations, semi-structured interviews and analysis of internal documents. Additional valuable data was also collected in a university-based research laboratory following a "living lab" approach (Loeh et al. 2005) whereby RFID-enabled processes were modelized and technological scenarios were tested and validated.

The detailed field research and the living lab approach involved six researchers (two professors and four Ph.D. students). 52 additional people were also involved in the study including key executives and staff members from the six above mentioned organisations and several senior managers from some leading-edge technology-based firms acting as RFID solution providers including ERP, RFID hardware components, middleware, integrators and process modelization providers.

6.4. Results

6.4.1. The Receiving Process Without RFID

The receiving process starts once the truck has backed up into the receiving dock and the paper Bill of Lading (BoL) for the merchandise has been handed off to the BoL clerk. It includes the data and physical handling necessary so that the product is ready to be put-away. Figure 6.1 presents the usual drill down approach for the receiving process from the more aggregate vision to the more detailed one. In order to simplify the presentation only two levels are displayed in figure 6.1.

The information displayed represents the schematized synthesis of the real-life observations in the six investigated organisations. Their respective receiving processes were compared in order to derive a generic receiving process. The process presented here corresponds to a highly efficient environment. These organisations are rather technologically advanced since they use barcoding, optical scanners linked to central computers through a wireless networking, specialized software such as a Receiving System and a Warehouse Management System (WMS) which is integrated with an Enterprise Resource Planning (ERP) software. They also place a strong emphasis on the coordination and collaboration between the supplier and the client. The process is presented in the context of a warehouse because they usually have higher volumes and therefore the processes are more sophisticated and complex. By demonstrating that RFID can improve a highly efficient receiving process, we are also implying that it can improve the less efficient ones.

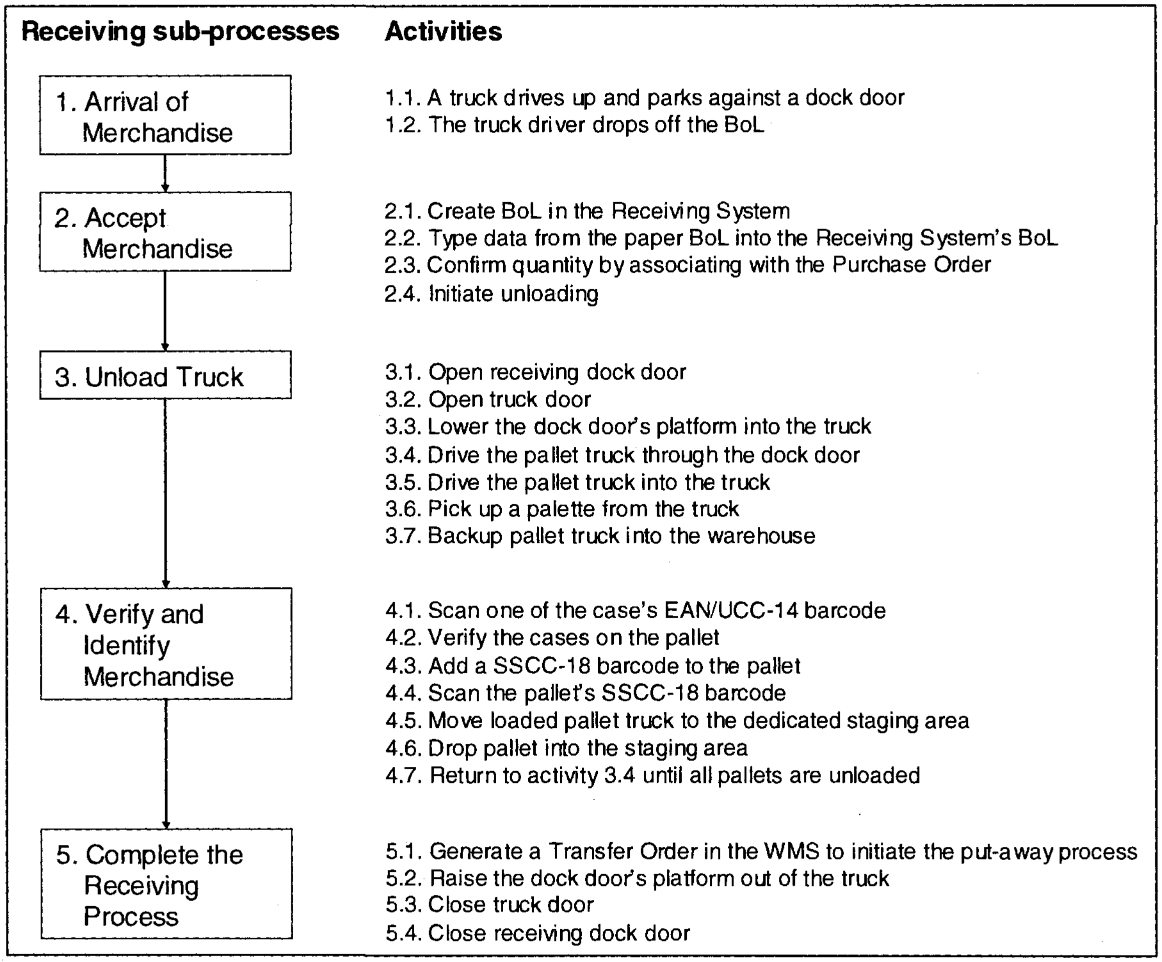

Figure 6.1: The current efficient receiving process of a warehouse.

Of course, slight variations to this process exist. The client could require that the supplier already affix its pallets with a SSCC-18 (Serial Shipping Container Code) barcode or another type of identifier. When this is the case, activity "*4.3 Add a SSCC-18 barcode to the pallet*" is no longer necessary. The client could also require that the supplier send an Advanced Ship Notice (EDI transaction # 856) at the time of the shipment. In such a case, the supplier is affixing its pallets with SSCC-18 barcodes as well as electronically sending the information required to interpret the barcode. The electronic document arrives before the physical shipment so that activities from "*2.1. Create BoL in the Receiving System*" to "*2.4. Initiate unloading*" are no longer necessary.

Depending on the quality of the previous shipments, the client may also need to physically or visually inspect the content of the pallet. The pallet may be taken apart. The cases may be opened. An item may be removed for sampling and quality assurance. This can be performed during activity "*4.2. Verify the cases on the pallet*". The more detailed the inspection, the more expensive it becomes.

6.4.2. The RFID-Enabled Automated Receiving System

An RFID system depends highly upon its environment and the product that will be tagged. Table 6.2 provides a summary of the different configurations necessary for each RFID system in the six organisations under investigation.

Table 6.2 : Technical characteristics of the RFID system in the six organisations

		RFID Configuration				
		Data	Readers	Tags	Middleware	Main Feedback
Organisation	M1	On the network	Mobile Readers Handheld Readers	Passive UHF tag with a plastic spacer	Pure play	Audible beep Mounted monitor
	DC1	On the network	Mobile Readers Handheld Readers	Passive UHF pallet smart labels Permanent tags	WMS module	Audible beep Mounted monitor
	DC2	On the network	Mobile Readers Handheld Readers	Passive UHF pallet smart labels Permanent tags	WMS module	Audible beep Mounted monitor
	DC3	On the tag	Mobile Readers Handheld Readers	Passive UHF pallet smart labels Permanent tags	WMS module	Audible beep Mounted monitor
	DC4	On the tag	Handheld Readers	Passive UHF tag with a plastic spacer	ERP module	Audible beep Handheld monitor
	R1	On the tag	Fixed Readers Handheld Readers	Passive UHF pallet smart labels Passive UHF case smart labels	Pure play	Light stacks

As displayed in Table 6.2, the RFID system differs from one organisation to the next in terms of:

6.4.2.1. Location of data

RFID-enabled automated receiving requires replacing the different types of barcodes by smart labels. Smart labels are simply RFID tags glued to an adhesive label. Depending on the specificities of each organisation and of the supply chain they belong, the RFID architecture can differ. The smart labels could possibly contain only a unique identifier such as an EPC if the specific data resides on a shared network. Similar to a barcode, the identifier on the label has no meaning unless one looks up the data to which it is associated in a database. In the case of M1, DC1 and DC2, it is recommended to use the EPC network because the data will be shared more easily by the various business partners who will come in contact with the tag.

Alternatively, if the data resides on the tags themselves (Diekmann et al. 2007) as it is the case for DC3, DC4 and R1, the tags will contain any and all information deemed necessary for the receiving process to be accomplished. The data on the case smart label could contain the following information: EAN/UCC-14 identifier, product description and lot number. The data on the pallet smart label could contain the following information: SSCC-18 identifier, quantity in pallet, order number, PO (Purchase Order), BoL. A company may decide to add additional data fields such as the name of the truck driver, the shipment time and destination, storage requirements, etc. In the cold chain, an RFID battery assisted semi-passive tag can record the temperature and various states of the product during transportation. In the case of DC3 and R1, it is recommended to put the data directly on the tag and save the costs associated to using the EPC network because it is a closed loop supply chain. In the case of DC4 it is necessary that the data be directly on the tag even though the business network functions in an open loop because the Internet will not always be accessible in the outdoor environment.

6.4.2.2. RFID readers

The system requires that RFID readers be in a relatively close proximity to the smart labels during the receiving process. It is recommended that the antennas that are connected to the readers have a circular polarization. Although a linear polarized antenna will be able to read tags further if their orientation can be guaranteed, a circular polarized antenna will provide better read rates in an environment where the tags may not be properly aligned with the reader's antenna. Three different options exist in terms of reader selection. The choice of an option will impact how the RFID enabled automated receiving process will be performed as well as its costs.

6.4.2.2.1. Reader Option #1: Fixed RFID Readers

This option consists of installing fixed RFID readers at of the dock doors. The reader's antennas are then placed on each side of the dock door behind protective bollards at the height at which the products will pass. This configuration is referred to as an RFID portal. When the forklift or pallet truck passes through the RFID portal during activity "*3.7. Backup pallet truck into the warehouse*", the tags are automatically scanned. The advantage of this option is that it significantly reduces the activities necessary in the receiving process. It also offers more efficient read rates than the other reader options because it uses more antennas Its main disadvantage is that it requires more investment than the other two options described below. Additionally, this option may not permit to capture all the case smart labels. If the items within the cases on the pallet contain metal, liquid or other dielectric components then it may be difficult to obtain a tag read of the cases located in the middle of the pallet because of their influence on RF propagation. Another factor limiting the capacity to read the cases in the middle of the pallets is tag shadowing. Tag shadowing occurs when multiple tags are in close proximity which can occur with tagged cases on a pallet. Tags are continuously being improved in order to be read more effectively and at greater distances. Paradoxically, this can sometimes be a problem when it causes false positive reads. They occur when an RFID tag is being read by a neighbouring reader. RFID portals will therefore be installed with presence of detectors and a RF reflective surface like a metal mesh. The presence detectors ensure that the portal is only turned on when necessary. The metal mesh will isolate the reader's signal to the vicinity of the portal. Figure 6.2 shows an RFID portal near a dock door. A feedback mechanism is installed on the wall to indicate the last pallet smart label to be scanned. A camera can also be mounted on the wall as is the case in figure 6.2. The camera is positioned right above the feedback mechanism and takes a picture when a tag is scanned for optional auditing purposes. It is recommended that R1 use an RFID portal because it has a limited number of dock doors. The forklift mounted RFID reader alternative is not an option because it does not use forklifts at the store. Although it could install the reader on one of its pallet trucks, an RFID portal ensures that all shipments arriving at the location are scanned even if they are not palletized.

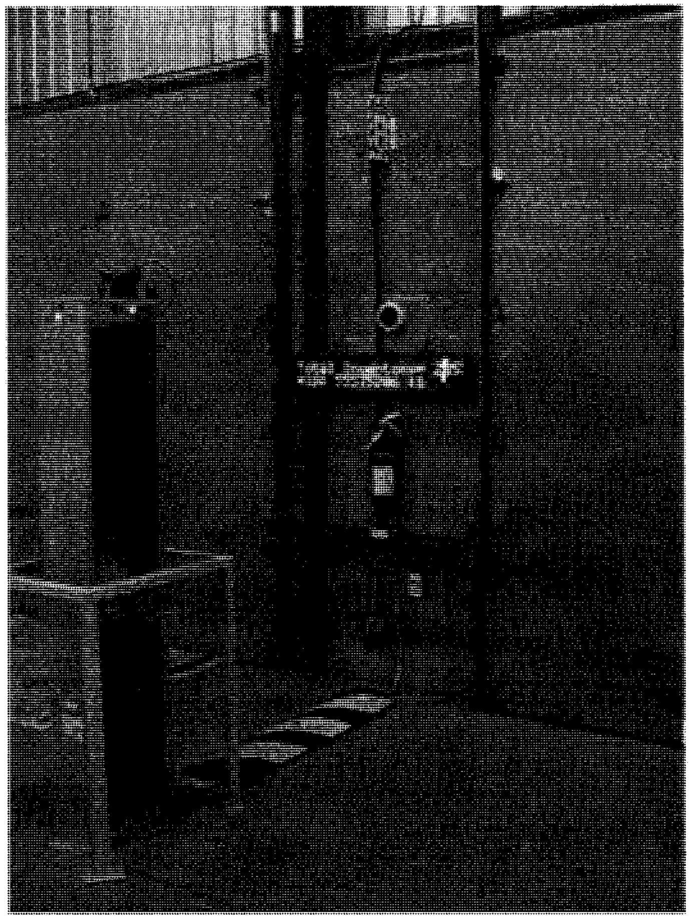

Figure 6.2 : An RFID portal as can be used at R1

6.4.2.2.2. Reader Option #2: Mobile RFID Readers

This option consists of mounting an RFID reader on the forklifts or pallet trucks instead of near the dock doors. Although the readers are not fixed in this option, it should be noted that every option still requires a fixed reference point. The fixed reference points serves to associate an activity to a location. For the mobile RFID reader option, it is possible to use permanent RFID tags which will be located near the dock door that the forklift will pass through. When the forklift is in close proximity of the pallet, it will scan the smart label and download the information it contains. It will also scan the permanent RFID tag located near the dock door thereby associating the event with a location.

The advantages of this configuration over RFID portals are numerous. Firstly, fixed RFID readers as their name implies are fixed to a given location. This greatly reduces the visibility of the product in the warehouse to only the dock doors. Because a pallet will always be moved with a forklift or pallet truck, a forklift mounted mobile reader will always provide the last location of a pallet anywhere in the warehouse where permanent RFID tags are located. Secondly, a typical warehouse has fewer forklifts than dock doors. Purchasing costs and installation costs of the new system are thus greatly reduced. It is recommended to use the mobile RFID readers at M1, DC1, DC2 and DC3 because it will be more economical than to install RFID portals at every dock door. DC4 should also use a mobile RFID reader because the receiving process is performed outdoors and therefore it is not guaranteed that the arriving shipment will pass through a portal. Although the unit level at DC4 is an item, each individual item is carried on a pallet. Therefore, even though the item is tagged, the forklift can still read it when it takes the pallet.

6.4.2.2.3. Reader Option #3: Handheld RFID Readers

The handheld RFID reader offers the least benefits in terms of process improvements compared to the two previous options because a certain level of manual intervention is still required. This option is more of a “semi-automated” receiving process. The handheld reader is a mobile reader which is carried by an employee as illustrated in figure 6.3. It is composed of a rugged exterior and contains a keyboard and a terminal. It offers the advantages of portability in remote locations. For example, if receiving is performed in a temporary location or one that is not accessible by an RFID mounted forklift, then the handheld reader is an interesting alternative. Unfortunately, its portability has to be offset by a reduced Effective Radiated Power (ERP) in order to reduce the consumption of the limited battery power supply. Rather than be considered as an alternative to RFID portals and RFID mounted forklift readers, the handheld reader can also complement the other equipment options for exception processing. When a problem shipment needs to be investigated or a pallet needs to be broken down during activity *"4.2. Verify the cases on the pallet"*, then the handheld reader is very useful. For this reason, all the organisations studied can also use the handheld RFID reader in their receiving process.

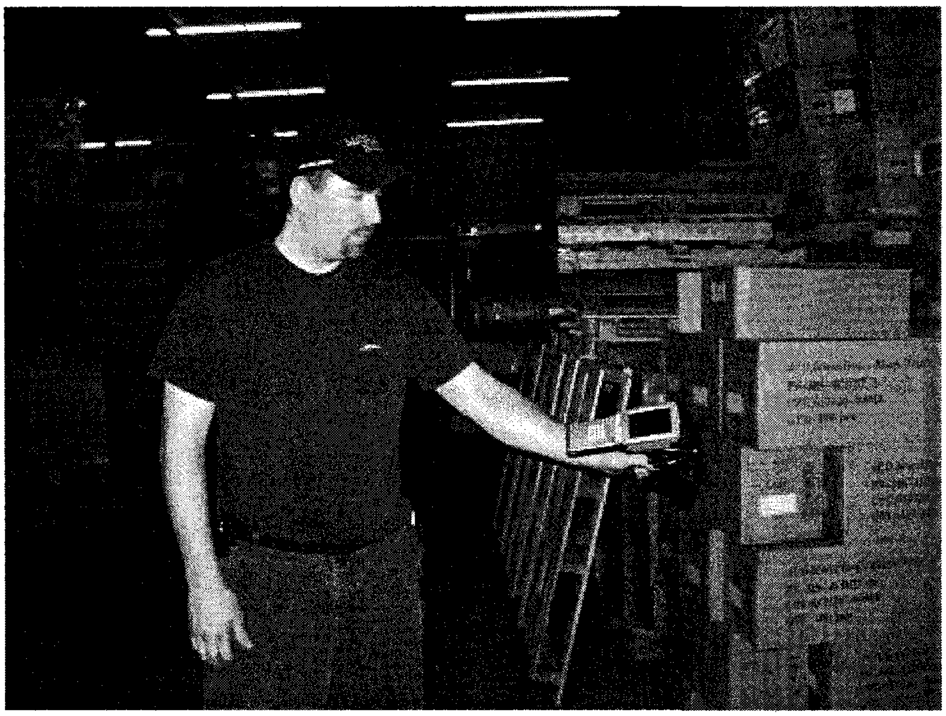

Figure 6.3 : Handheld RFID reader

6.4.2.3. RFID tags

Four types of RFID tags may be used for the automated receiving process. Firstly, the smart labels will be affixed to the pallet and will become the "pallet tag" at DC1, DC2, DC3 and R1. Secondly, permanent RFID tags may be installed near the receiving dock doors or any other location that needs to be automatically identified during the receiving process. M1, DC1, DC2 and DC3 will use permanent RFID tags because mobile RFID readers and dock doors are used at these locations. Some organisations may decide that permanent RFID tags during receiving are optional. Indeed, it may not matter through which receiving dock door the shipment came through as long as its content.is properly identified and verified. However, these tags are relatively inexpensive and can provide valuable information that can be used during data analysis such as dock door usage, being able to separate events by location, etc. Thirdly, smart labels may also be affixed on each case within the pallet. They are not necessary in order to perform automated receiving at the pallet level but should an error occur during the receiving process, they will improve exception processing during activity "*4.2. Verify the cases on the pallet*". Smart labels at the case level are however necessary to automate the receiving process at R1 because not all shipments arrive on pallets. Fourthly, smart labels will be affixed at the unit level at M1 and DC4. UHF RFID is not generally used for item level tagging because its far field properties (as defined by ISO 18000-6C) are not designed to isolate individual items. If the objective in automated receiving is not to provide individual tracking nor the capacity to isolate a single item, a UHF smart label can be used for automated receiving at the item level. Special care must be taken when choosing this particular smart label, because the item's composition might contain more metal or water than the corrugated cardboard of the cases and pallets. In the case of M1 and DC4, a plastic spacer was put between the tag and the item to create an air gap. The following text covers this issue in more detail.

RFID inlays are tags that are used in smart labels. They exist in a variety of sizes, forms, costs, range, memory size, etc. Since the inlays are an integral part of the smart label, the same characteristics apply to them. The choice of tag to use will therefore be highly dependent on the nature of the project and the environment in which they are to be used. Nonetheless, it is possible to give some generic indication of the type of tags to use.

Since it is highly unlikely that the tags' orientation can be guaranteed during the receiving process, it is recommended to use an RFID inlay containing a dual dipole antenna. Additionally, certain inlays are optimized according to the material they will come in contact with. For example, some smart labels are designed to perform efficiently when affixed to corrugated cardboard. The location where the tag or smart label will be placed greatly influences its readability. It is therefore important to consider dynamic and static air gaps in the products or packaging. An air gap behind the tag will offer ideal tag performance. It is best to use a static air gap when possible as this will ensure that an air gap is always behind the tag. The geographical location of the tag is also important as different regions of the world determine the frequency to use. Although these considerations can greatly increase the performance of the system, it is nonetheless crucial to test various types of tags in order to find the most appropriate one.

6.4.2.4. RFID middleware

The RFID middleware software ensures the bridge between the RFID architecture and the organisation's central data repositories like the Receiving System, WMS or ERP. The middleware is often referred to as the intelligent portion of the RFID system because it manages and coordinates it. The middleware will associate read items with an activity and a location. It also sends commands to the readers to reprogram the tags. It will clean the raw data to limit false positives and then filter the data before sending it to the receiving system, WMS or ERP. This is a necessary procedure as the latter are not designed to store vast amounts of data gathered by the RFID system. DC4 decided to use a middleware developed by their ERP manufacturer because their IT department has taken the decision to standardize all software on this platform. D1, DC2 and DC3 have opted to use a middleware provided by their highly specialized WMS. M1 decided to use a middleware provided by a "pure play" company that services smaller organisations. R1 has opted for a pure play middleware solution because its existing software does not currently provide an RFID module.

6.4.2.5. Feed-back mechanisms

Feedback mechanisms are an important part of the RFID system but are seldomly covered when describing the basic RFID components. Nonetheless, they are required in order to provide a signal capable of being interpreted by a human that will indicate an error in the automation process. This will inform the employee to intervene by processing the exception. Feedback mechanisms can take the form of light stacks, audible devices such as horns or monitors such as the one present on figure 6.2 for the receiving process at R1. Organisations M1, DC1, DC2 and DC3 use forklift mounted mobile readers which provide an audible beep when a tag is read and transmits information to a monitor mounted on the forklift. DC4 uses a handheld reader which provides an audible beep and information about the tag on the handheld monitor when it is read.

6.4.3. Derived Benefit

RFID enabled automated receiving can provide a number of benefits to the organisations studied as presented in Table 6.3. These benefits have been regrouped under the following categories: streamlining current processes, improving the quality of information, improving the quality of process execution, enabling business process re-engineering and creating RFID externalities.

Table 6.3: Benefits from RFID enabled automated receiving for each organisation.

Benefits	M1	DC1	DC2	DC3	DC4	R1
Streamlining current processes						
Instantaneous data acquisition	+	+	+	+	+	+
Instantaneous verification	+	++	++	+++	+	+++
Reduced paperwork	+	+	++	+	+	+
Reduced errors	+	++	+++	++	+	++
Reduced bottlenecks	+	++	+++	++	+	++
Reduced assets	+	++	++	++	+	+++
Improve the quality of information						
Paperwork gets filled out	+	++	++	+	+++	++
Fewer claims	+	+++	+++	+	+	++
Better informed management decisions	+	+	++	+	+	++
Improve the quality of process execution						
Better management and control of operations	+	++	+++	++	+	+
Quicker shipments or replenishment	+	++	++	++	+	++
Enabling Business Process Re-engineering						
Cross-dock possibility	n/a	n/a	++	n/a	+	n/a
Create smart processes	+	++	++	++	+	++
Creating RFID externalities						
Downstream benefits	+++	++	++	++	+++	+

+ some benefits, ++ relatively high benefits, +++ high benefits

6.4.3.1. Streamlining current processes

6.4.3.1.1. Instantaneous data acquisition

The nature of RFID is to automate the capture and transmission of data related to a product's identification. In the receiving process presented in figure 6.1 the following activities are therefore eliminated with the RFID system.

1.2. The truck driver drops off the BoL

2.1. Create BoL in the Receiving System

2.2. Type data from the paper BoL into the Receiving System's BoL

4.1. Scan one of the case's EAN/UCC-14 barcode

4.3. Add a SSCC-18 barcode to the pallet

4.4. Scan the pallet's SSCC-18 barcode

6.4.3.1.2. Instantaneous verification

As data from the smart label is captured by the RFID system, the enterprise system can automatically perform the verification activities. When the system is properly configured and integrated, the following tasks are automated.

2.3. Confirm quantity by associating with the Purchase Order

4.2. Verify the cases on the pallet

The benefits from this category will be more significant when many items need to be verified as is the case when the unit level is a pallet at DC1 and DC2 instead of an item at M1 and DC4. It reaches a peak when the shipment is a mixed pallet of various items like at DC3 and R1.

6.4.3.1.3. Reduced paperwork

Paper-based information is less efficient than electronically stored data. There is a cost associated with transmitting paper-based information. It has a tendency of being misplaced. It is also bulkier and retrieving it is slower while at the same time requires more effort to copy and manipulate the data it contains. The following activities during the receiving process include paperwork that can be eliminated with the RFID application.

1.2. The truck driver drops off the BoL

4.2. Verify the cases on the pallet

6.4.3.1.4. Reduced errors

Even though current receiving processes can be very efficient, they are still error-prone because of human intervention. Our field study indicates that errors can occur at several locations especially when the process is not followed as specified. Environments with high volume, open loop networks where an ASN is not available and organisations where work is performed manually are more error prone and therefore better candidates to RFID benefits.

6.4.3.1.5. Reduced bottlenecks

An improved movement of goods during the receiving process and fewer errors translate into a higher throughput. The improved throughput makes a bottleneck less likely. When they occur, they potentially halt all other receiving activities and create a queue. Benefits will be more significant for high volume receiving processes where bottlenecks currently occur.

6.4.3.1.6. Reduced assets

Because the receiving process is performed more quickly, fewer assets involved in the receiving process are required. For example, since throughput is increased, the dock doors used by the trailers have a quicker turnover. Fewer dock doors are now necessary. The same reasoning applies to very coveted warehouse real estate which is freed up: the receiving dock and staging area.

Additionally, fewer forklifts and their drivers are necessary to accomplish the same output. Instead of reducing the employee headcount, it can rather mean allocating more employees facing the customer which is one of R1's strategic goals.

6.4.3.2. Improve the quality of information

6.4.3.2.1. Paperwork gets filled out

Filling out paperwork is often considered as tedious by employees. When it is filled out, it sometimes contains errors. RFID eliminates paperwork because all the necessary documentation is automatically created. This ensures that is not only gathered, but gathered correctly. This benefit is especially useful in an outside environment where it is less pleasant to fill out paperwork in the rain or in the cold as is the case at DC4. Also, sometimes employees have little time or are less motivated to fill out the paperwork. RFID thus makes the information more available and reliable.

6.4.3.2.2. Fewer claims

A very significant pain point for both suppliers and clients are the numerous claims that occur when a discrepancy in shipments occurs. This is due to shrinkage which includes breakage, misplacements, poor bookkeeping or theft (Levy et al. 2004). It creates conflict in the relationship between the buyer and seller. It is costly because of the time spent in order to resolve the contentious matter and because of the money spent to compensate the lost goods. RFID during the receiving process can assist in identifying who is responsible for the shrinkage. This is especially useful in open loop networks where there is a high volume of receiving as is the case with DC1 and DC2.

6.4.3.2.3. Better informed management decisions

Improved quality of information can lead to better informed management decisions. For example, by knowing which goods have already been received, redundant inventory will not be ordered. This reduced inventory in addition to obviously improving cash flow also has the additional benefit of freeing up warehouse floor space, reducing variable costs such as insurance costs and avoiding depreciation costs on inventory that is not used. It can also improve the management of faster moving items that need to leave the warehouse as soon as possible like at DC2 or at a retail store to reduce Out of Stocks like at R1.

6.4.3.3. Improve the quality of process execution

6.4.3.3.1. Better management and control of operations

An efficient process requires that all of the activities be continuously performed in the same optimized manner. Humans do not like repetitive tasks. In our field study we noticed that employees would introduce variety in the receiving process. Sometimes the documented process was not performed as suggested. This observation occurred when comparing different employees performing the same tasks and also when comparing a single employee performing the same task at different occasions at DC1 and DC3. The RFID system can ensure that the process is performed as prescribed. This is especially useful when many employees work on different parts of the same process as is the case at DC2. The system can coordinate the activities and ensure that the process is completed correctly.

6.4.3.3.2. Quicker shipments or replenishment

Since RFID enabled automated receiving improves the throughput of goods, they have less propensity to arrive late at their destination. This means that the application ensures that Just-in-Time can be executed more efficiently. Environments with faster moving goods can benefit more from this aspect.

6.4.3.4. Enabling Business Process Re-engineering

6.4.3.4.1. Cross-dock possibility

Instead of using RFID to create incremental benefits in the receiving process, it is possible to think outside the box and use it to radically change the way the current warehouse is organized. One such a way as to use RFID to enable cross-dock activities if the product is not managed under a First In First Out (FIFO) method (Fosso et al). In this case, the following receiving activity "*4.5 Move loaded forklift to the dedicated staging area*" is bypassed along with the subsequent put-away and picking process because the goods are moved directly to shipping. This is applicable only in the warehouses of DC2 and DC4.

6.4.3.4.2. Create smart processes

The facilitated real-time data acquisition and additional visibility that are provided by RFID can enable new sets of business processes. These smart processes can immediately trigger an event or another process when a specific RFID tag is read in a given situation (Fosso Wamba et al. 2006). These can be for example alert notifications when « hot items » that are in strong demand have arrived and should be treated in priority. Smart processes are still in their nascent phase and have yet to be developed and widely adopted by organisations. Nonetheless the potential they have to offer is interesting.

6.4.3.5. Creating RFID externalities

6.4.3.5.1. Downstream benefits

When a receiving process is automated with RFID, it implies that a smart label is affixed to the pallet, case or item. The smart label is still affixed to the unit during the following processes. Therefore the put-away process, picking process and shipping process can benefit from the infrastructure that was put in place to optimize the receiving process. It is also possible to use the same smart label for the client's receiving process. As the tagged unit moves down the supply chain, it can create additional benefits. The longer the tag remains in use, the more benefits can be derived from it. For example, the tag on the item at M1 and DC4 can be used during its entire lifecycle thereby enabling Product Lifecycle Management (PLM). In R1's retail environment, the pallet or case to which the tag is affixed is quickly disassembled and the tag looses its meaning.

6.5. Conclusion

Based on the results of a comprehensive field study carried out in six organisations, this chapter presents the technical considerations that will influence the configuration of an RFID enabled automated receiving application and demonstrates that technical challenges are numerous since such an application requires customization depending on the type of products, the characteristics of the network, the volume of activity, the unit level and the position in the supply chain. Benefits derived from this type of RFID application are dependent not only on the characteristics of the RFID platform but also the chosen RFID configuration. A preliminary but rather comprehensive list of benefits derived from the field study represents a useful analysis tool to determine the full benefits that can be derived from the application in a given organisation.

Results also point to the overriding importance of managerial considerations related to supplier adoption. In an open loop network, RFID enabled automated receiving clearly impacts the supplier and this represents a major consideration when implementing the application. Client mandates are usually perceived by the supplier as generating additional costs while contributing few benefits. This can create a conflictual situation in the buyer-seller relationship as many reports indicated was the case at Wal-Mart (Fogarty, 2004; Romanow, 2004; Schwartz, 2004; Keizer, 2004). Early adopters agree that the supplier must also see benefits for the application to be adopted by both parties (Schwartz, 2004). In fact, the biggest obstacle to successfully implementing this RFID application is not tied to technical issues but rather to obtaining supplier buy in.

RFID enabled automated receiving application optimizes a process which is shared between buyer and seller and thus should contribute to build a collaborative advantage. In the context of RFID enabled automated receiving, the client shares the mandate requirements and numbering schema to be used. In return, the supplier sends a tagged shipment and electronic information which can be transmitted through EPC network when the data is not on the tag. In addition to this basic form of collaboration that is required between supplier and client to perform the essential functions of RFID enabled automated receiving, it is also possible for the supplier to capitalize on some benefits from the application. For example, the higher quality and speed of acquisition of the information that has been gathered by the client because of the supplier can be shared back with the supplier in the form of feedback. As an additional incentive, the client could decide to accelerate the payment of the shipment because the possible claims are resolved more efficiently and quickly. Further research on the advantages for the supplier to assist the client in performing automated receiving is clearly necessary and is also expected by the industry.

CHAPITRE 7. DISCUSSION GÉNÉRALE ET RECOMMANDATIONS

Ce chapitre reprend l'ensemble des résultats provenant des articles de thèse pour offrir une discussion plus englobante en fonction des propositions de recherche formulées au chapitre 3. La figure 7.1 présente la manière dont les cinq articles viennent supporter les propositions de recherche à partir de notre cadre conceptuel. Dans la figure, le premier article présenté correspond à la mention A1; le deuxième, à la mention A2; et le troisième, à la mention A3 tandis que les deux articles présentés en annexe correspondent à A4 et A5.

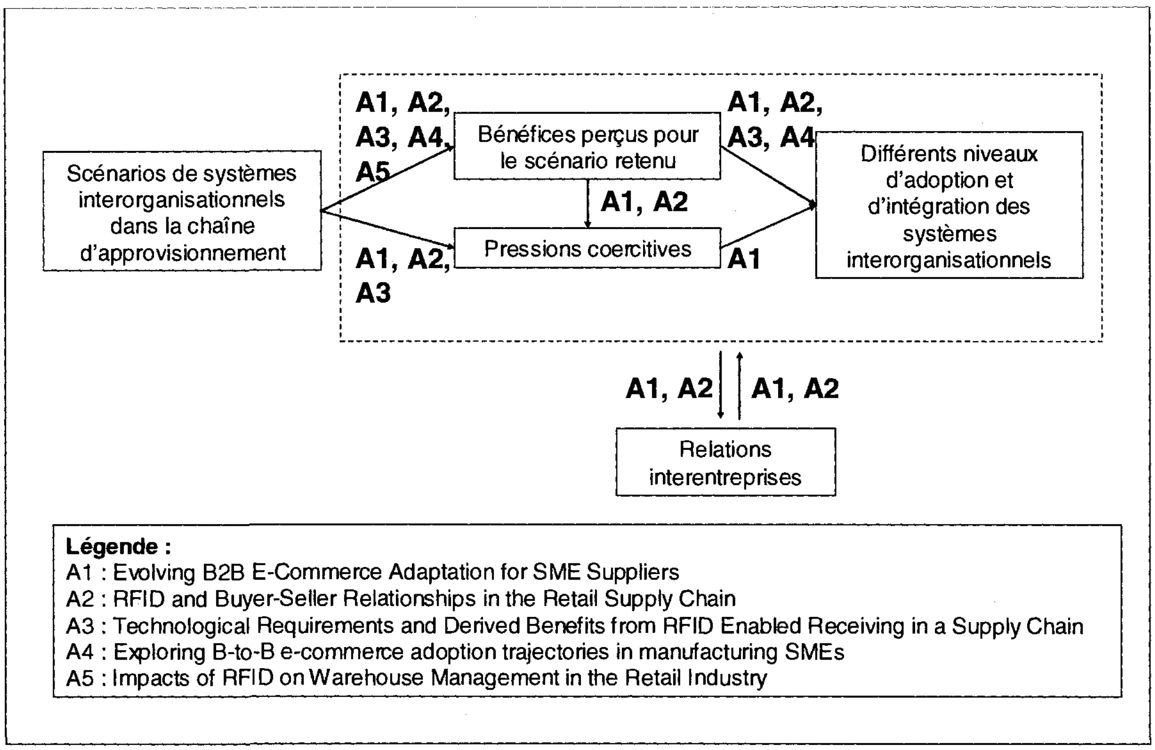

Figure 7.1 : Support des propositions de recherche selon les articles de thèse

7.1. Proposition 1

Notre première proposition postulait que différents scénarios d'utilisation de systèmes interorganisationnels influenceraient les bénéfices perçus. Le premier article, présenté au chapitre quatre, supporte cette proposition en présentant les différents impacts d'affaires que peuvent avoir différentes technologies pour le même processus d'affaires. Par exemple, les deux donneurs d'ordres influents utilisent différents types de places d'affaires selon les mêmes stades de relations. Ce faisant, elles visent différents objectifs, et par conséquent, envisagent différents bénéfices. Le deuxième article, présenté au chapitre cinq, supporte également cette première proposition. Ainsi, lorsqu'une entreprise décide d'utiliser le réseau EPC pour échanger des données captées à partir des puces RFID, les bénéfices peuvent alors se déplacer vers l'amont de la chaîne. Si l'entreprise décide plutôt d'utiliser un réseau privé qui n'incite pas au partage, alors les bénéfices se déplacent surtout en aval. Le troisième article présente trois scénarios pour un système RFID, en l'occurrence des lecteurs fixes, mobiles ou portatifs, et démontre que le système avec des lecteurs portatifs est plus accessible dans l'entrepôt par exemple et engendre plus de flexibilité au niveau de la gestion des inventaires. Le quatrième article, quant à lui, tisse un lien direct entre l'aspect cumulatif des bénéfices engendrés par des niveaux de plus en plus avancés d'adoption des applications de commerce électronique. Finalement, l'article 5, présente une méthodologie proposée par les chercheurs du centre ePoly pour élaborer les scénarios technologiques et, plus spécifiquement, analyse les bénéfices générés grâce à la technologie RFID dans les processus de réception et de remisage. Parmi les bénéfices envisagés, il faut noter l'émergence d'une pratique logistique appelé le cross-docking, qui entraîne des avantages concurrentiels importants au niveau des frais d'entreposage et du juste-à-temps.

Notons que ces cinq articles viennent tous supporter notre première proposition.

7.2. Proposition 2

Notre deuxième proposition partait du principe qu'il pourrait exister un certain écart technologique entre l'entreprise instigatrice et l'entreprise incitée, que l'emplacement dans le réseau social que représente une chaîne d'approvisionnement confère plus ou moins d'influence à certains membres de cette chaîne, et que les objectifs d'affaires des différents membres soient possiblement divergents. Les scénarios de systèmes interorganisationnels envisagés par l'entreprise investigatrice pourraient donc entraîner l'entreprise incitée à percevoir des pressions coercitives.

En ce qui concerne l'écart technologique présent entre l'entreprise instigatrice et l'entreprise incitée, le premier article a clairement démontré cette dichotomie qui existait entre les donneurs d'ordres influents et les petites et moyennes entreprises qui étaient bien plus réticentes à modifier leurs pratiques actuelles vers un mode numérique. Celles-ci étaient moins avancées technologiquement et possédaient moins de ressources que les entreprises instigatrices.

Le deuxième article illustre bien que les pressions coercitives diffèrent selon l'emplacement de l'entreprise incitée dans le réseau social, et ce dépendamment du scénario retenu. Ainsi les manufacturiers sont sujets à des pressions plus intenses lorsque l'application de la puce RFID doit se faire au niveau de l'item ou du produit. Si l'application de la puce doit se faire au niveau de la caisse, il se pourrait que les pressions coercitives se fassent ressentir par un autre membre de la chaîne d'approvisionnement : dans la chaîne d'approvisionnement étudiée, c'est sur le distributeur que le poids des pressions coercitives se ferait sentir. Le scénario présenté dans le troisième article, où nous examinons le processus de réception automatisé grâce à la technologie RFID, implique nécessairement l'adoption de cette technologie par les fournisseurs pour les bénéfices de leurs clients. Ainsi, toute entreprise qui désire optimiser son processus de réception devra exercer des pressions auprès de ses fournisseurs pour qu'ils intègrent la technologie RFID.

En ce qui concerne la présence d'objectif d'affaires divergents entre l'entreprise incitée et l'entreprise instigatrice, le premier article nous présente le cas d'un fournisseur qui préfère investir dans ses propres processus manufacturiers plutôt que d'automatiser les transactions avec son donneur d'ordre. Ce fournisseur, malgré qu'il fasse l'objet de fortes pressions de la part de son client (pressions coercitives), décide plutôt de refuser de s'y soumettre. Dans le cas du deuxième article, certains membres de la chaîne d'approvisionnement ont avantage à appliquer la puce RFID à certains niveaux du produit tandis que d'autres pourraient tirer des avantages plus substantiels à intégrer cette technologie à d'autres niveaux. Cette situation pourrait potentiellement entraîner une situation conflictuelle où une entreprise du réseau se sentirait forcer de s'adapter aux exigences de l'entreprise plus puissante. Dans le troisième article, nous présentons les bénéfices que l'entreprise instigatrice gagne grâce à l'utilisation de la technologie RFID pour d'optimiser son propre processus de réception. Dans ce cas, les bénéfices pour l'entreprise incitée (ici le fournisseur) sont beaucoup plus faibles et elle subit une pression de la part de son client.

Ces résultats de recherche, présentés dans les articles de thèse démontrent que des pressions coercitives peuvent bel et bien être ressenties de la part des entreprises incitées selon les scénarios technologiques retenus par les entreprises investigatrices.

7.3. Proposition 3

Cette proposition s'appuie fortement sur la théorie de la diffusion de l'innovation de Rogers où la variable la plus importante pour expliquer l'adoption d'une innovation est celle des bénéfices perçus. Nous proposons ici que les bénéfices perçus influencent non seulement la décision d'adopter ou non de manière dichotomique, mais qu'ils influencent également le niveau d'intégration des systèmes interorganisationnels.

Les cinq articles présentés dans la thèse traitent des applications de commerce électronique interentreprises et de la technologie RFID. Dans le contexte du commerce électronique, un faible niveau d'intégration des systèmes interorganisationnels signifie qu'un certain traitement manuel est nécessaire pour que l'information puisse circuler d'une entreprise à l'autre. Un fort niveau d'intégration signifie que l'information a libre cours et peut circuler automatiquement à l'intérieur des entreprises sans implication de la part d'un être humain. Dans le contexte de la technologie RFID, une situation de faible intégration représente un système isolé qui n'est pas intégré au système déjà en place. Inversement, une situation de forte intégration implique alors un système RFID intégré aux systèmes en place tel un progiciel de gestion intégrée (ERP), un système de gestion de l'entrepôt (WMS) ou un système d'exécution de la fabrication (MES). Le concept d'intégration va cependant beaucoup plus loin et peut impliquer également l'automatisation de l'utilisation de cette nouvelle technologie Une forte intégration de la technologie RFID peut signifier que l'entreprise automatise la pose des puces RFID sur les produits, caisses ou palettes plutôt que d'utiliser une pose manuelle que l'on appelle le « slap & ship ».

Le premier article nous présente une situation où l'entreprise instigatrice, afin d'obtenir plus de bénéfices, augmente tranquillement le nombre de systèmes interorganisationnels à adopter au fur et à mesure que le fournisseur passe à travers les stades de relation (pré-relation, relation ponctuelle, relation contractuelle, relation collaborative). Ainsi, si la relation avec le deuxième donneur d'ordres est, par exemple, au stade de pré-relation, le fournisseur aura à utiliser les courriels et le Web. Au stade de relation ponctuelle, le fournisseur aura à utiliser une place d'affaires électroniques. Au stade de relation contractuelle s'ajoute une nouvelle place d'affaires, un système EDI, un système de transfert bancaire et l'utilisation d'un système de conception assistée par ordinateur.

Dans le deuxième article, cette proposition semble beaucoup moins claire. Les niveaux d'intégration de la technologie RFID qui ont été discutés par les entreprises restent à un niveau très faible. Rappelons que la technologie RFID, utilisée pour des fins tel que présentées dans l'article, est encore récente et même immature à certains égards. Les entreprises empruntaient plutôt une approche prudente en intégrant la technologie de façon limitée à un processus et à une gamme de produits malgré les nombreux bénéfices potentiels présentés dans le troisième article. L'article présenté dans l'annexe A, quant à lui, démontre clairement que les bénéfices perçus de plus en plus importants encouragent les entreprises à passer des processus électroniques de recherche d'information, aux processus transactionnels, puis aux processus transactionnels plus complexes et finalement à la collaboration électronique.

À la lumière de cette discussion, il semblerait que la proposition 3 pourrait être nuancée de la façon suivante Lorsqu'une technologie a été éprouvée, le niveau de bénéfice perçu aura plus de propension à influencer le niveau d'adoption et d'intégration des systèmes interorganisationnels. Lorsqu'une technologie est plus récente et a moins fait ses preuves, telle la technologie RFID, les entreprises restent prudentes et intègrent la technologie à un niveau relativement faible.

7.4. Proposition 4

La quatrième proposition part du principe que l'adoption du système interorganisationnel dans le but d'augmenter l'efficacité de la chaîne d'approvisionnement par l'entreprise instigatrice dépend également de l'adoption par ses partenaires. Ainsi, plus l'attrait pour ce scénario sera élevé et plus l'entreprise instigatrice l'imposera sur l'entreprise incitée.

Le premier article nous présente une situation où les deux donneurs d'ordres font face à une situation où l'amélioration de la chaîne d'approvisionnement leur apporte non seulement des bénéfices importants, mais présente également une nouvelle réalité d'affaires obligatoire. Afin d'obtenir une performance accrue, ces entreprises exercent clairement des pressions coercitives sur les fournisseurs inclus dans l'étude. Le deuxième article présente une situation où l'adoption de la technologie RFID au plus petit niveau d'étiquetage (l'item plutôt que la caisse, la palette ou le camion) procure plus de bénéfices à l'entreprise instigatrice (ici le détaillant), et vient simultanément ajouter plus de coûts à l'entreprise incitée, (dans ce cas-ci le manufacturier) qui aura tendance à s'opposer à ce scénario.

7.5. Proposition 5

La cinquième proposition suggère que l'entreprise incitée réagira positivement face aux pressions coercitives exercées par l'entreprise instigatrice. De plus, elle suggère que l'entreprise incitée pourra réagir selon différents niveaux d'adoption et d'intégration.

Le premier article est très important pour valider ou infirmer cette proposition. En effet, le thème central de l'article se concentre sur l'adaptation des entreprises incitées face aux pressions coercitives des entreprises instigatrices. Dans celui-ci, nous dénotons clairement le rôle important des pressions coercitives pour expliquer l'adoption du commerce électronique par les petits et moyens fournisseurs. Ces fournisseurs bénéficient d'une marge de manœuvre plutôt limitée quant au choix du niveau d'adoption et d'intégration puisque la technologie et le processus à utiliser sont dictés par les entreprises instigatrices. Cependant, les fournisseurs peuvent déterminer à quel point leur système interne serait intégré avec le système interorganisationnel proposé. Dans la plupart des cas, ce niveau d'intégration est limité.

7.6. Proposition 6

Il a également été proposé que les relations interentreprises, évaluées grâce à huit dimensions clef (la communication et le partage d'information, la coopération, la confiance, l'engagement, la valeur de la relation, le déséquilibre du pouvoir et l'interdépendance, l'adaptation et le conflit) aient un effet modérateur sur les propositions P1 à P5.

La proposition P1 suggère un lien entre les scénarios d'utilisation du système interorganisationnel et les bénéfices perçus. Le premier article vient supporter l'influence de la variable des relations interentreprises sur cette proposition puisque si l'engagement mutuel entre les entreprises est minimal, il n'y aura pas de projet conjoint. Le deuxième article nous explique que la confiance influence les bénéfices perçus. Si une entreprise croit que ses partenaires tenteront de détourner le système RFID pour rencontrer ses propres besoins, les bénéfices perçus pour le scénario retenu en sont affectés négativement.

Les relations interentreprises viennent également modérer la deuxième proposition. Une bonne communication entre les partenaires viendra réduire les pressions coercitives que ressentira l'entreprise incitée envers l'implantation des scénarios d'utilisation des systèmes interorganisationnels En effet, dans le premier article, nous avons noté un manque de confiance envers l'entreprise instigatrice, ce qui a augmenté le ressentiment des pressions coercitives. Dans l'étude présentée dans le deuxième article, l'entreprise instigatrice fait très attention aux communications qui sont envoyées aux partenaires afin de minimiser leur perception de pressions coercitives. La troisième proposition, qui tisse un lien entre les bénéfices perçus et les différents niveaux d'adoption et d'intégration, est modérée par la capacité d'adaptation de l'entreprise incitée. Dans le premier article, nous remarquons que les entreprises instigatrices avancent plus lentement que désiré afin de s'ajuster au rythme des entreprises incitées.

La quatrième proposition établit un lien entre les bénéfices perçus par l'entreprise instigatrice et les pressions coercitives qui seront imposées sur l'entreprise incitée. En effet, la variable des relations interentreprises, par le biais de la dimension du déséquilibre du pouvoir et l'interdépendance, influence fortement le niveau de pressions coercitives induites. Le premier article présente justement une situation où le pouvoir est très fortement déséquilibré et où les pressions coercitives sont flagrantes.

La cinquième proposition établit un lien entre les pressions coercitives ressenties par l'entreprise incitée et sa propension à adopter et intégrer les systèmes interorganisationnels proposés par l'entreprise instigatrice. Encore une fois, la dimension du déséquilibre du pouvoir et de l'interdépendance viendra modérer la réaction de l'entreprise incitée face aux pressions coercitives. Dans le premier article, certains fournisseurs n'ont pas ressenti le besoin de s'adapter aux exigences des entreprises instigatrices puisqu'elles se sentaient plus autonomes que leurs homologues.

Nous en concluons donc que la variable des relations interentreprises modère les propositions P1, P2, P3, P4 et P5 du modèle proposé pour l'adoption des systèmes interorganisationnels dans un contexte de chaîne d'approvisionnement.

7.7. Proposition 7

La dernière proposition suggère que les pressions coercitives par l'entreprise instigatrice viendront modifier sa relation avec l'entreprise incitée.

Le premier article présente plusieurs exemples où cette situation s'applique, ce qui représente un soutien pour la proposition 7. Suite à l'utilisation de pressions coercitives pour encourager l'adoption de systèmes interorganisationnels par les entreprises incitées, une situation conflictuelle s'est clairement déclarée. La confiance s'est grandement détériorée tel que démontré par les commentaires de la Coalition et du Fournisseur C qui croient que les donneurs d'ordre n'ont que leurs propres intérêt à cœur. Dans certains cas, comme le démontre l'expérience du Fournisseur B et du Fournisseur C, l'engagement envers la relation s'en est trouvé affecté. Ces deux fournisseurs ont choisis de remettre en question la relation avec leurs clients. De la part des donneurs d'ordre, la mise en place des systèmes interorganisationnels a significativement réduit l'engagement de ces entreprises envers certains fournisseurs. Le donneur d'ordres 2, par exemple, a éliminé 70% de ses fournisseurs suite à la mise en place de cette initiative.

Cependant, notons que l'influence du modèle sur les relations interorganisationnelles n'est pas que négative. Certaines entreprises incitées croient que l'adaptation aux pressions coercitives entraînera éventuellement une augmentation dans la valeur de la relation. Le fournisseur F croit que la relation deviendra moins coûteuse à maintenir car une partie importante des transactions seront automatisées. Le deuxième article nous présente aussi un cas où l'adoption de la technologie RFID viendra réduire les contentieux et donc augmenter le niveau de confiance qui règne parmi les partenaires.

Les résultats présentés dans le cadre de la thèse viennent donc supporter en grande partie nos propositions de recherche.

7.8. Recommandations

Les résultats présentés nous permettent d'émettre certaines recommandations pour les groupes qui pourraient bénéficier de cette recherche.

7.8.1. Recommandations industrielles

La première série de recommandations rejoint les entreprises qui sont touchées par un projet technologique visant à améliorer la gestion de la chaîne d'approvisionnement.

Notre recherche permet à l'entreprise qui désire se doter d'une telle technologie interorganisationnelle de mieux comprendre la dynamique relationnelle entourant l'initiative envisagée. Elle sera donc en mesure de mieux prédire l'impact de l'adoption et de l'intégration des systèmes interorganisationnels sur ses propres relations interentreprises à court terme et à plus long terme. Elle pourra de plus prendre des initiatives appropriées pour stimuler l'appropriation de la technologie chez ses propres partenaires dans la chaîne d'approvisionnement.

Notre recherche permet également à l'entreprise qui reçoit le mandat d'adopter une technologie de gestion de la chaîne d'approvisionnement de mieux tirer son épingle du jeu. Elle possédera un meilleur outil pour analyser les exigences de l'entreprise instigatrice et, dans le cas où elle reçoit des pressions coercitives, elle pourra mieux se positionner face à ses concurrents.

Notre dernière recommandation touche les entreprises qui fournissent des solutions technologiques de gestion de la chaîne d'approvisionnement. Ces fournisseurs technologiques pourraient augmenter leurs propres chiffres d'affaires. En effet, en ayant une meilleure appréciation de la dynamique interorganisationnelle lors de l'adoption de ces systèmes, elles seront plus en mesure de conseiller leurs clients et donc, augmenter leurs ventes.

7.8.2. Recommandations académiques

La deuxième série de recommandations vise le domaine académique. Premièrement, notre recherche offre aux chercheurs dans le domaine de la gestion de la chaîne d'approvisionnement et, de façon générale aux chercheurs en génie industriel, des résultats qui soulignent l'importance des relations interentreprises sur l'adoption et l'intégration des applications de commerce électronique interentreprises et de la technologie RFID dans un contexte de chaînes d'approvisionnement. Nous recommandons donc de considérer la structure de la chaîne d'approvisionnement et l'influence des liens relationnels qui existent entre les entreprises membres de cette chaîne pour l'analyse des facteurs d'adoption et d'intégration de systèmes organisationnels.

Notre recherche contribue au domaine du management de la technologie en soulevant l'existence des pressions coercitives et l'importance la théorie de l'institutionnalisme et des réseaux sociaux lors des études d'adoption et d'intégration des systèmes interorganisationnels. Ces concepts théoriques viendront renforcer la théorie de la diffusion des innovations proposées par Rogers (2003).

Enfin, notre recherche nous permet aussi d'émettre des recommandations aux chercheurs dans le domaine du marketing industriel (par opposition au marketing de grande consommation destiné aux individus) qui représente environ 70% des échanges commerciaux. Il est essentiel de considérer les multiples dimensions des relations interentreprises (tout au moins les huit dimensions que nous avons relevées) lors de l'élaboration et la mise en place de stratégies de gestion de la chaîne d'approvisionnement.

CHAPITRE 8. CONCLUSION ET PROCHAINES AVENUES DE RECHERCHES

8.1 Contributions

Suite aux résultats présentés dans les différents articles, nous pouvons maintenant tenter de cerner les contributions de cette thèse, qui se situent principalement sur deux plans, le plan conceptuel et le plan méthodologique.

8.1.1. Sur le plan conceptuel

De façon générale, chacun des articles apporte un éclairage nouveau sur le processus d'adoption des systèmes interorganisationnels et contribue dans une certaine mesure à l'avancement des connaissances dans ce domaine de recherche. Ainsi, le premier article permet de mieux cerner le rôle des pressions coercitives, ce qui va à l'encontre de la littérature où les systèmes interorganisationnels sont souvent présentés comme un moyen de passer des relations transactionnelles vers des relations plus collaboratives. Le deuxième article présente la variable des relations interentreprises comme étant un déterminant important de l'adoption et de l'intégration des systèmes interorganisationnels mais cette adoption et intégration modifient à leur tour les relations interentreprises. Cette co-évolution entre relations interentreprises et infrastructure technologique mérite des efforts de recherche dans le futur. Le troisième article contribue surtout aux connaissances industrielles en démontrant que l'importance relative des bénéfices engendrés par l'utilisation de la technologie RFID pour supporter le processus de réception automatisée dans un entrepôt diffère d'entreprise en entreprise selon leur position dans la chaîne d'approvisionnement.

Les résultats de cette thèse démontrent également l'existence d'un phénomène que l'on pourrait appeler le paradoxe collaboratif. Celui-ci stipule que certaines entreprises, dans le but d'améliorer la collaboration dans leur chaîne d'approvisionnement iront déstabiliser les relations qu'elles entretiennent avec leurs partenaires d'affaires. Par exemple, lorsqu'un client influent induit des pressions coercitives auprès de ses fournisseurs pour qu'ils adoptent des systèmes interorganisationnels dans le but de resserrer les relations entre les membres d'une chaine d'approvisionnement, une situation conflictuelle peut être créée au point de rompre les relations interentreprises. Dans le cas où la valeur de la relation est suffisamment importante, l'engagement subsistera aux pressions coercitives et entraînera une hausse de la communication et du partage de l'information et, éventuellement amènera des relations plus étroites. Dépendant du niveau de pouvoir exercé, du niveau de coopération existant et du niveau de confiance engendré, la déstabilisation de la relation peut être importante ou non. Cet effet pervers de l'adoption et de l'intégration des systèmes interorganisationnels sur les relations interentreprises n'a été pour l'instant que très peu exploré dans la littérature.

8.1.2. Sur le plan méthodologique

La démarche méthodologique peut être considérée comme innovante puisqu'elle intègre des méthodes qui proviennent à la fois des domaines des sciences de la gestion et des sciences appliquées. En effet, les études sur le terrain combinent des méthodes largement utilisées en gestion, telles que les études de cas par exemple tandis que les simulations en laboratoire correspondent plus au domaine des sciences appliquées et les études de temps et mouvements proviennent largement du génie industriel. Par contre, la cartographie des processus est une démarche commune aux deux domaines.

La démarche méthodologique est également innovante puisqu'elle tente de cerner l'adoption et l'intégration des processus interorganisationnels à plusieurs niveaux, au niveau du processus (par exemple, le processus de réception), au niveau de l'entreprise et au niveau de la chaîne d'approvisionnement. Notons plus spécifiquement que notre recherche a permis d'analyser plus que des relations dyadiques (clients-fournisseurs), ce qui reste rarement le cas dans la littérature pour tenter d'explorer les relations interentreprises à plusieurs niveaux de la chaîne d'approvisionnement. Mentionnons que le troisième article analyse les relations interentreprises à quatre niveaux de la chaine d'approvisionnement. Enfin, le fait d'obtenir de l'évidence empirique dans trois industries différentes, soit les métaux primaires, la vente au détail et le secteur de l'énergie, garantit une certaine validité externe. Rappelons aussi que le premier article traite d'une industrie rarement étudiée, celle des métaux primaires.

8.2 Avenues de recherche

Notre recherche exploratoire repose sur diverses approches méthodologiques, combinant à la fois des données qualitatives et quantitatives. Elle a permis de valider et de nuancer les sept propositions de recherche. Cependant, la recherche ne se concentrait que sur deux types de systèmes interorganisationnels avec un nombre limité d'organisations observées. La validité externe et le pouvoir de généralisation des résultats des trois articles de thèse restent relativement limités bien que notre étude sur le terrain ait porté sur des chaînes d'approvisionnement dans trois industries. Ces limites nous ouvrent maintenant des pistes pour les prochaines avenues de recherches. Par exemple, il serait de mise d'analyser la synergie entre divers systèmes organisationnels (applications de commerce électroniques interentreprises, la technologie RFID et autres systèmes interorganisationnels). En effet, plusieurs auteurs soulignent l'importance de la technologie RFID pour intégrer la chaîne d'approvisionnement : par exemple, le « Collaborative Planning Forecasting and Replenishment » (CPFR) et le « Efficient Consumer Response » (ECR) deviennent des systèmes viables grâce à la technologie RFID et certains concepts comme la gestion du cycle de vie du produit (Product Life Cycle Management) deviennent opérationnels. De plus, l'étude sur le terrain a permis de cerner plusieurs variables de recherche ouvrant la voie vers des mesures quantitatives et à des enquêtes à grande échelle, ce qui permettrait d'obtenir des données quantitatives de plusieurs entreprises simultanément et générerait des résultats généralisables statistiquement.

Sur le plan conceptuel, le paradoxe collaboratif soulevé par les résultats empiriques de la thèse mérite des efforts de recherche additionnels. De plus, il serait intéressant d'expliquer le faible niveau de collaboration observé parmi des entreprises qui tentent d'intégrer leur chaîne d'approvisionnement ensemble. Cela pointe vers une question de recherche qui pourrait être examinée dans le futur : est-ce que les relations interentreprises représentent un antécédent à l'utilisation et à l'intégration de technologies collaboratives? Parmi les deux sources de motivation étudiées, soit les bénéfices perçus et les pressions coercitives, laquelle est la plus convaincante, la plus efficace, et dans quelles circonstances devrait-elle être utilisée par l'entreprise instigatrice pour influencer ses partenaires d'affaires. Nous avons noté que les bénéfices perçus et les pressions coercitives peuvent avoir un impact sur l'adoption dans certaines entreprises incitées. Or, si l'étude des bénéfices perçus nous permet de constater des trajectoires d'adoption, de quelle manière est-ce que les pressions coercitives les influencent-elles?

Ces prochaines avenues de recherche pourraient constituer des projets de recherche qui s'appuient sur les résultats de cette thèse.

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ANNEXE A. EXPLORING B-TO-B E-COMMERCE ADOPTION TRAJECTORIES IN MANUFACTURING SMES

Abstract

The intent of this paper is to capture the gradual unfolding of business-to-business (B-to-B) e-commerce adoption in small and medium-sized enterprises (SMEs). Empirical evidence was gathered in three separate but complementary phases: first, a pilot study to identify and validate metrics for B-to-B e-commerce adoption; second, an e-survey to gain an in-depth understanding of B-to-B e-commerce adoption and its related benefits; and third, a multiple case study to further validate the e-commerce adoption trajectories we observed and their underlying dynamics. Findings suggest logical evolutionary paths to the penetration of B-to-B e-commerce in SMEs. The cumulative and self-reinforcing nature of both e-commerce initiatives (i.e. eBP) and the benefits derived therefrom points to the existence of e-commerce adoption trajectories.

Keywords.

B-to-B e-commerce, SMEs, adoption trajectories, cumulative benefits

A.1. Introduction

Electronic commerce (e-commerce) represents a highly pervasive innovation (Prananto et al. 2003) that is leading to significant changes in the traditional ways of doing business. The intent of this paper is to capture the gradual unfolding of business-to-business (B-to-B) e-commerce adoption in small and medium-sized enterprises (SMEs). More specifically, the objectives are as follows:

(i) to propose and validate a stage model of B-to-B e-commerce adoption in the specific context of manufacturing SMEs;

(ii) to assess whether B-to-B e-commerce initiatives are undertaken in a cumulative and path-dependent way and to explore whether SMEs follow e-commerce adoption trajectories;

(iii) to determine whether the benefits derived from e-commerce adoption are self-reinforcing as SMEs gain more experience with e-commerce initiatives.

This line of inquiry seems particularly relevant for several reasons. First, B-to-B e-commerce represents roughly 70% to 85% of total e-commerce activities (OECD, 2004; The Economist, 2004). Second, SMEs appear to be lagging behind their larger counterparts (Drew, 2003) despite the considerable efforts made by governmental agencies to accelerate e-commerce adoption among SMEs (eEurope Action Plan, 2002; OECD, 2002; OECD, 2004; US Department of Commerce, 2002b). Third, our collective knowledge of e-commerce issues in SMEs remains scarce (Jeffcoate et al. 2002; Kendall et al. 2001) and is even slimmer in the case of B-to-B e-commerce (Gebauer and Shaw, 2002).

The paper is structured as follows. In the next section, we briefly outline previous work on e-commerce penetration measures, build on the evolutionary theory to propose the concept of e-commerce adoption trajectories, and examine some of the relevant literature regarding benefits related to B-to-B e-commerce. This is followed by a discussion of the methodology (section A.3). The results are then presented and discussed (section A.4). The last section concludes with contributions and implications (section A.5).

A.2. Theoretical Issues

A.2.1. Measuring B-to-B e-commerce penetration: An integrative and business process approach

E-commerce has been narrowly defined as buying and selling over the Internet but, from a broader perspective, "e-commerce is considered as the use of Internet and related technologies to support any activity that is necessary for an organization to function effectively" (Magal et al. 2001). The latter definition is retained here. Since organizations first started to use EDI (Electronic Data Interchange) systems a few decades ago (Gebauer and Shaw, 2002), electronic integration between manufacturers and their business partners (subcontractors, suppliers, distributors, customers, etc.) has grown steadily. In fact, the advent of Internet and Web-based technologies has opened up new avenues for B-to-B e-commerce, in particular hybrid e-commerce solutions such as Internet-EDI (Chan and Swatman, 2004). B-to-B e-commerce also implies exchanging and sharing information within the firm itself or with external stakeholders (Daniel et al. 2002) and therefore supports both intra- and inter-organizational processes through public (e.g. on the Internet) and private networks (e.g. Extranet and Intranet).

Some indicators previously used to assess e-commerce penetration rely on connectivity measures, such as access to the Internet, and the types of information and telecommunications technologies used, see for instance, (Grandon and Pearson J.M., 2003; Riquelme, 2002; US Department of Commerce, 2002b; Van Beveren and Thomson. H., 2002). Other studies provide monetary figures related to e-commerce transactions (OECD, 2002; Statistics Canada, 2001). These studies offer valuable indicators but are of little help in understanding how organizations rely on e-commerce to support their ongoing activities. Some pioneering work has been done on e-commerce activities as a whole (Bertschek and Fryges, 2002; US Department of Commerce, 2002a) and on e-commerce business processes and capabilities (Zhu and Kraemer, 2002). More recently, authors such as (Elia et al. 2003) have attempted to derive new e-commerce metrics based on business processes. Advocates for this latter approach believe that this "process view is a more dynamic description of how an organization acts" (Magal et al. 2001). Furthermore, this process view provides a cross-functional perspective that is typical of the reality of e-commerce and allows one to focus on the value creation processes in firms. We will therefore retain business processes as the unit of analysis for measuring e-commerce penetration. In other words, we propose to identify, at the firm level, which business processes are carried out electronically in the manufacturing context.

A.2.2. E-commerce adoption from an evolutionary perspective: Path dependency, trajectories and stage models in SMEs

In evolutionary theory, the focus is on the explanation of dynamic behavior over time (Burgelman, 1983; Nelson, 1982). We will draw heavily from the rich body of literature in this field to retain two crucial concepts: path dependency and trajectories. E-commerce adoption is considered here as "path-dependent" in the sense that the outcome depends on how adoptions accumulate (Arthur, 1987). Prior experience and knowledge gained from that experience allow new knowledge to be assimilated and exploited (Cohen and Levinthal, 1990). Path dependency implies a dynamically self-reinforcing behavior, whether this behavior is triggered by historical accidents or by rational decisions. Technological trajectories (Dosi, 1982) suggest the existence of sequences of innovations. Given that e-commerce is considered to consist of clusters of separate innovations (Daniel et al. 2002; Lertwongsatien and Wongpinunwatana, 2003) making up a technology system (Rosenberg, 1982), rather than a single technology, e-commerce adoption trajectories appear to be a concept that warrants further investigation.

Such a line of inquiry falls within the realm of exploratory research for several reasons. First, the existence of common patterns of e-commerce adoption among SMEs remains unclear (Craighead and Laforge, 2003). Second, the sequential nature of e-commerce adoption by SMEs and, consequently, the existence of a stage model are not fully demonstrated (Fillis et al. 2004) except for a few exceptions (Chan and Swatman, 2004; Daniel et al. 2002; Rao et al. 2003). Third, there is a lack of research into the strategic plans for future use of e-commerce by SMEs (Drew, 2003), which represents a prime concern among SMEs' managers (Damaskopoulos and Evgeniou, 2003). To our knowledge, no prior study has examined progression paths and e-commerce adoption trajectories.

A.2.3. Benefits derived from e-commerce in the specific context of SMEs

SMEs' alleged vulnerability to problems during e-commerce adoption may be exaggerated. Without a doubt, SMEs lack the financial and non-financial resources to implement sophisticated technologies. Previous work also demonstrates that SMEs manage their internal and external information systems less formally than large corporations (La Rovere, 1996) and do not adequately plan the use of ICTs (Lees and Lees, 1987). Still, these smaller firms have become more "sophisticated" (Bergeron and Raymond, 1992). Furthermore, their CEOs appear to be becoming more aware of the importance of e-commerce (Grandon and Pearson J.M., 2003); they are finding that, by using the Internet, they can achieve the same benefits associated with EDI without making substantial investments (Boyer and Olson, 2002); thus, they are able to capitalize on the potential of e-commerce.

Among the alleged benefits, SMEs often rank the increased visibility offered by a Web presence as one of the most important motivations behind their e-commerce initiatives (OECD, 2004). E-commerce is also said to level the playing field for smaller firms (OECD, 2002) by expanding their market reach, reducing market entry barriers and targeting market segments more effectively. Consequently, an increase in revenues and market share can be expected. E-commerce also allows improved customer relations and communications (Sadowski et al. 2002; Santarelli and D'altri, 2003) and improved customer services in general (Chan and Lee, 2003). With the more advanced B-to-B e-commerce initiatives, SMEs move from arm's-length relationships to more cooperative relationships, especially in the context of supply chain management (Lefebvre et al. 2003b). The result is a reduction in inventory cost and delivery time (Frohlich and Westbrook, 2002; Turner, 2000), procurement (Chan and Lee, 2003), logistics and distribution costs (Gunasekaran et al. 2002; Lancioni et al. 2000) and engineering, product development and design costs (Kothandaraman and Wilson, 2001).

Based on the above discussion, e-commerce appears to be a viable solution even for smaller firms.

A.3. Research Design and Methodology

The empirical evidence was gathered in three separate but complementary phases: first, a pilot study to identify and validate metrics for B-to-B e-commerce adoption; second, an e-survey to gain an in-depth understanding of the gradual unfolding of the B-to-B e-commerce adoption and its related benefits among manufacturing SMEs; and third, a multiple case study to further validate the e-commerce adoption trajectories we observed and their underlying dynamics. This sequential qualitative-quantitative approach seems particularly appropriate for exploratory research (Creswell, 1994; Tashakkori and Teddlie C., 1998).

A.3.1. Phase 1: The pilot study

As discussed in section A.2.1, we favored an integrative and process-based approach. The major difficulty encountered in this first phase resides in the identification and validation of a broad set of business processes which can be conducted using electronic means. The three-step pilot study encompasses separate sources of information:

Step 1: Simulations of simple and advanced e-commerce applications carried out with the CEOs of SMEs. These transfer activities reached some 1,503 organizations over the last four years and allowed us to obtain a first set of business processes that can be conducted electronically.

Step 2: Five focus groups with CEOs of manufacturing SMEs. The first set of business processes, classified during step 2 under five generic functional activities (product development, engineering and design; procurement/purchasing; production/operations; sales, marketing and after-sales services; and production logistics) were validated by the focus groups.

Step 3: One panel of experts. The business processes were further validated by a panel of twelve independent experts. Using the Delphi method, the experts also reached a consensus concerning the relative degree of complexity of each of the business processes retained in step 2.

The pilot study, which is in line with the grounded theory approach (Strauss and Corbin, 1990), allows us to first propose a stage model for e-commerce adoption based on 36 business processes, and then classify SMEs according to which stage they are at.

A.3.2. Phase 2: The e-survey

A systematic sample was drawn from an up-to-date government list of all manufacturing SMEs operating in one Canadian province. The list included the name and electronic address of the CEO, as well as some key characteristics of the firm (such as the number of employees and the geographic location). CEOs of the selected firms were contacted by e-mail and asked to participate in an on-line survey. Compared to traditional mail-in questionnaires, an electronic survey offers some advantages such as the creation of a more interactive and attractive instrument, the reduction in handling costs and response cycle time, as well as the elimination of errors due to data re-entry (Couper, 2000; Dillman, 2000; Rogelberg et al. 2001). A few years ago, the lack of generalized access to the Internet was considered a potential shortcoming for on-line surveys, but it no longer represents an important issue since the vast majority of Canadian SMEs are now connected to the Internet (OECD, 2004). It is, however, acknowledged that the use of an electronic survey minimizes the number of non-adopters of e-commerce who can take part.

No significant differences (goodness of fit tests) were found between respondents and non-respondents with respect to firm size. However, the response rate was slightly higher for urban areas. The overall response rate reached 7.67%, which is quite acceptable for an electronic survey. A total of 192 manufacturing SMEs participated in the survey. Subsequent data analyses were performed on these 192 firms.

A.3.3. Phase 3: The multiple case study

Among the 192 SMEs which participated in the e-survey, we selected two firms per stage of the observed stage model, for a total of twelve firms. For each of these firms, multiple sources of evidence were used to allow triangulation (Miles and Huberman, 1994; Yin, 2003): (i) publicly available information; (ii) internal reports and other documents, and (iii) on-site semi-structured interviews with senior managers. All of the data from the multiple sources were thoroughly examined, coded and analyzed. For interview data, within- and cross-case analysis was performed.

A.4. Findings

As the research design includes three phases and the results of each phase build upon the findings of the preceding one, we will present the results in a consecutive fashion.

A.4.1. Findings of the pilot study

A.4.1.1. E-commerce initiatives by broad generic functions: A business-process approach

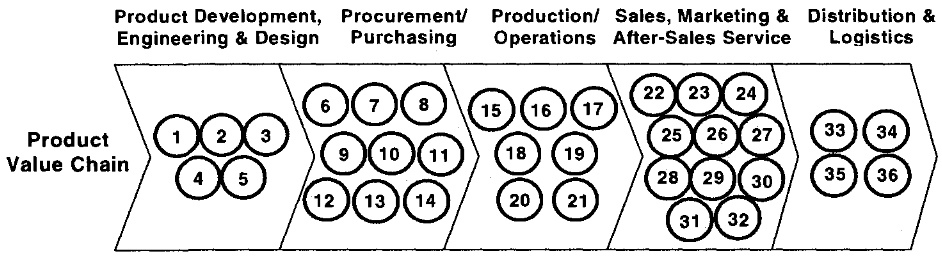
Thirty-six business processes which can be carried out in an electronically mediated environment (eBPs) were thoroughly validated with the five focus groups. As shown in figure A.1, these processes cover the five generic functions usually found in manufacturing firms: product development, engineering and design; procurement and purchasing; production and operations; sales, marketing and after-sales service; and distribution and logistics. Figure A.1 indicates that e-commerce could potentially pervade all five functions. Support functions such as human resources management or information and telecommunication services were not retained as they tend not to be formally organized in an SME context.

It can also be observed from figure A.1 that some eBPs, such as “seek out new customers,” are present in non-manufacturing firms while others, such as “automate the production floor,” are specific to a manufacturing context. Hence, the proposed typology of the 36 eBPs is rather broad and subsets of eBPs could be derived for SMEs in the service sector or in wholesale and retail commerce.

A.4.1.2. E-commerce initiatives and the proposed adoption stage model

Results from the focus groups also allowed us to derive a stage model (upper part of figure A.2) that differentiates non-adopters (stages 00 and stage 0) from adopters (stages 1, 2, 3 and 4). Stage 00 refers to non-adopters with no intention of getting involved in any e-commerce initiatives, whereas firms at stage 0 are not presently conducting any e-commerce activity but are planning to do so within the next 12 months. In order to capture the different stages of B-to-B e-commerce penetration among adopters, we have distributed the same 36 eBPs shown in figure A.1 among stages 1, 2, 3 and 4 (middle part of figure A.2). Stage 1 indicates that SMEs are only conducting activities related to electronic information search and content creation (eBP6, eBP7, eBP23 and eBP22, eBP24). Stage 2 represents simple e-transactions such as buying products/services using electronic catalogs (eBP8) while stage 3 includes more complex e-transactions such as participating in electronic auctions (eBP9, eBP26) or negotiating contracts on-line (eBP12, eBP28). Stage 4 considers a wider range of e-commerce capabilities that support e-collaboration with customers and suppliers. The panel of twelve experts confirmed the validity of the stage model.

Functional Activities



eBPs by broad generic functional activities:

Product Development, Engineering & Design:

eBP1. Transfer documents and technical drawings to customers.
eBP2. Transfer documents and technical drawings to suppliers.
eBP3. Integrate software supporting product design (e.g. CAD/CAM, VPDM, PDM).
eBP4. Do collaborative on-line engineering with suppliers.
eBP5. Do collaborative on-line engineering with customers.

Procurement/Purchasing:

eBP6. Seek out new suppliers.
eBP7. Seek out products/services.
eBP8. Buy products/services using electronic catalogs.
eBP9. Buy products/services by electronic auction.
eBP10. Buy products/services by issuing electronic calls for tenders.
eBP11. Place and manage orders with suppliers.
eBP12. Negotiate contracts (price, volume, etc.) with suppliers.
eBP13. Make electronic payments to suppliers.
eBP14. Access suppliers' product/service databases.

Production/Operations:

eBP15. Automate the production floor using a manufacturing execution system (MES).
eBP16. Integrate the MES into the management information system.
eBP17. Ensure the management of quality assurance using the management information system.
eBP18. Allow customers to access the company's inventories.
eBP19. Access customers' inventories.
eBP20. Allow suppliers to access the company's inventories.
eBP21. Access suppliers' inventories.

Sales, Marketing & After-Sales Service:

eBP22. Advertise the company and/or its products/services.
eBP23. Seek out new customers.
eBP24. Convert information on products/services into digital form.
eBP25. Sell products/services using electronic catalogs.
eBP26. Sell products/services by electronic auction.
eBP27. Sell products/services by responding to electronic calls for tenders.
eBP28. Negotiate contracts (price, volume, etc.) with customers.
eBP29. Receive and manage customer orders.
eBP30. Receive electronic payments from customers.
eBP31. Access customers' product/service databases.
eBP32. Offer customers after-sales services.

Distribution & Logistics:

eBP33. Automate distribution/logistics using a logistics execution system (LES).
eBP34. Allow distribution/transportation partners to access the information they need (SKU, quantity, delivery turnaround, etc.) in order to reduce time and costs related to distribution.
eBP35. Optimize returns management ("reverse logistics").
eBP36. Track products (purchased and sold) during transportation.

Figure A.1 : Proposed typology of eBPs by major functional activity

Moving one step further into the validation of the proposed stage model, the panel of experts evaluated the relative level of complexity of each of the 36 eBPs (left-hand side of figure A.2). The Delphi method yielded two iterations before reaching a broad consensus. Inter-rater reliability between the members of the panel proved to be excellent for most business processes (ranging from 0.7 to 1.0) and satisfactory for the remaining ones (≥ 0.6). The mean level of complexity for all stage 1 eBPs (as evaluated by the twelve experts) was 1.50; the mean levels were 2.83 for stage 2 eBPs, 3.55 for stage 3 eBPs and 4.70 for stage 4 eBPs. This supports the assumption that complexity generally increases with the stages. It can therefore be assumed that as SMEs adopt eBPs from more advanced stages, they have to assimilate more complex technologies and undertake more complex organizational changes. The SMEs therefore need not only to acquire new technologies but to engage in a learning process to accumulate additional skills and knowledge related to the more advanced e-commerce initiatives.

The bottom part of figure A.2 indicates how two scores of e-commerce penetration can be derived. The first score of e-commerce penetration in one particular firm simply represents the sum of business processes that a firm conducts in an electronically mediated environment while the second score is weighted to reflect the level of complexity of each eBP. Hence, the weighted score is considered to be a more appropriate indicator of the level of e-commerce penetration.

Non-adopters		Adopters			
Stage 00	**Stage 0**	**Stage 1**	**Stage 2**	**Stage 3**	**Stage 4**
Non-adopters with no interest in e-commerce	Non-adopters with interest in e-commerce	Electronic information search & content creation	Electronic transactions	Complex electronic transactions	Electronic collaboration

Level of complexity	
1.50	**Stage 1: Electronic information search & content creation** eBP6. Seek out new suppliers eBP7. Seek out products/services eBP22. Advertise the company and/or its products/services eBP23. Seek out new customers eBP24. Convert information on products/services into digital form
2.83	**Stage 2: Electronic transactions** eBP8. Buy products/services using electronic catalogs eBP11. Place and manage orders with suppliers eBP14. Access suppliers' product/service databases eBP25. Sell products/services using electronic catalogs eBP29. Receive and manage customer orders eBP31. Access customers' product/service databases eBP32. Offer customers after-sales services
3.55	**Stage 3: Complex electronic transactions** eBP9. Buy products/services by electronic auction eBP10. Buy products/services by issuing electronic calls for tenders eBP12. Negotiate contracts (price, volume, etc.) with suppliers eBP13. Make electronic payments to suppliers eBP26. Sell products/services by electronic auction eBP27. Sell products/services by responding to electronic calls for tenders eBP28. Negotiate contracts (price, volume, etc.) with customers eBP30. Receive electronic payments from customers eBP18. Allow customers to access the company's inventories eBP19. Access customers' inventories eBP20. Allow suppliers to access the company's inventories eBP21. Access suppliers' inventories
4.70	**Stage 4: Electronic collaboration** eBP1. Transfer documents and technical drawings to customers eBP2. Transfer documents and technical drawings to suppliers eBP3. Integrate software supporting product design (e.g. CAD/CAM, VPDM, PDM) eBP4. Do collaborative on-line engineering with suppliers eBP5. Do collaborative on-line engineering with customers eBP15. Automate the production floor using a manufacturing execution system (MES) eBP16. Integrate the MES into the management information system eBP17. Ensure the management of quality assurance using the management information system eBP33. Automate distribution/logistics using a logistics execution system (LES) eBP34. Allow distribution/transportation partners to access the information they need (SKU, quantity, delivery turnaround, etc.) in order to reduce time and costs related to distribution eBP35. Optimize returns management ("reverse logistics") eBP36. Track products (purchased and sold) during transportation

Score of e-commerce penetration $= \sum_{i=1}^{36} eBP_i$ and weighted score of e-commerce penetration $= \sum_{i=1}^{36} c_i \times eBP_i$

Where eBP_i corresponds to the eBPs listed above ($eBP_i = 0$ when eBP_i is not conducted in one particular firm using electronic means and $eBP_i = 1$ when it is) and c_i = degree of complexity of each eBP as rated by a panel of 12 experts.

Figure A.2 : Proposed stage model for e-commerce penetration among manufacturing SMEs

Is the stage model proposed in figure A.2 fully anchored in the reality of manufacturing SMEs? The second phase of the research design, i.e. the e-survey, provides some answers to that question.

A.4.2. Findings of the e-survey

A.4.2.1. Profile of manufacturing SMEs and validation of the stage model

The information displayed in Table A.1 gives rise to a number of interesting observations:

(i) The group of non-adopters represents 19.8% of the responding firms ($n_1 = 38 + n_2 = 32$), which is comparable with the data provided by Canadian national agencies. Surprisingly, most of the non-adopters ($n_1 = 38$) show no interest in future e-commerce initiatives. Non-adopters (stages 00 and 0) are not significantly smaller than SMEs in the earlier stages of adoption (Stages 1 and 2).

(ii) Among adopters, firm size does seem to play a major significant role: there is a net progression between stages 1 and 4, where average annual sales increase from stage to stage (from CAN $18.13 million to CAN $139.19 million).

(iii) SMEs in stages 3 and 4 are significantly more active with regard to exports and imports.

Table A.1 also displays traditional indicators of e-commerce penetration: e-sales and e-procurement and the two e-commerce penetration scores. The results largely validate the proposed stage model, at least in the context of manufacturing SMEs, since the relative volume of electronic transactions and the two scores of e-commerce penetration increase significantly from stage to stage.

Table A.1 : Profile of manufacturing SMEs and validation of the proposed stage model for e-commerce penetration among manufacturing SMEs

	Non-adopters		Adopters				
	Stage 00	Stage 0	Stage 1	Stage 2	Stage 3	Stage 4	
	Non-adopters with no interest in e-com	Non-adopters with interest in e-com	Electronic information search & content creation	Electronic transactions	Complex electronic transactions	Electronic collaboration	
SMEs' characteristics	(n_{00} = 38)	(n_0 = 32)	(n_1 = 8)	(n_2 = 17)	(n_3 = 47)	(n_4 = 50)	P(1)
Size (annual sales in $CAN)	41.02M	31.53M	18.13M	23.34M	84.46	139.19M	NS
Level of exports	8.99M	8.08%	11.95%	8.78%	17.12%	16.97%	**
Level of imports	15.06M	11.69%	12.14%	8.12%	20.61%	32.45%	***
Volume of e-transactions							
% of e-sales(2)	N/A	N/A	0.00%	1.43%	9.29%	12.58%	****
% of e-procurement(3)	N/A	N/A	0.00%	0.98%	16.59%	21.27%	****
E-commerce penetration							
Score of e-commerce penetration	N/A	N/A	1.88	3.88	6.55	10.58	****
Weighted score of e-commerce penetration	N/A	N/A	2.79	8.22	15.66	31.93	****

(1) Where: p = level of significance of the Kruskal-Wallis Test (non-parametric ANOVA).
* = p < .10; ** = p < .05; *** = p < .01; **** = p < .001
(2) Ratio of e-sales over total sales
(3) Ratio of e-procurement over total procurement
NS = not significant N/A = not applicable

A.4.2.2. E-commerce adoption trajectories

If we closely examine the intended e-commerce strategies (simply measured here as the business processes that will be conducted by electronic means within a 12-month period), the following comments arise from Figure A.3:

(i) All non-adopters with an interest in e-commerce (stage 0) will move towards stages 1, 2, 3 or 4. Their interest in e-commerce seems likely to be reflected in future action.

(ii) Most SMEs (122 out of 154 firms or 79%) positioned at stages 0, 1, 2, 3 and 4 are following a trajectory: they will either progress within the same stage (i.e. they intend to perform electronically some additional business processes belonging to their current stage) or they will move on to the next stage (stage 0 to 1: 6 SMEs; stage 1 to 2: 3 SMEs; stage 2 to 3: 8 SMEs; stage 3 to 4: 30 SMEs).

(iii) Some SMEs (32 out of 154 firms or 21%) will leap over one or even several stages. The more inexperienced they are with e-commerce, the more they tend to follow this kind of leap-frogging: this is particularly evident with SMEs currently positioned at stage 0.

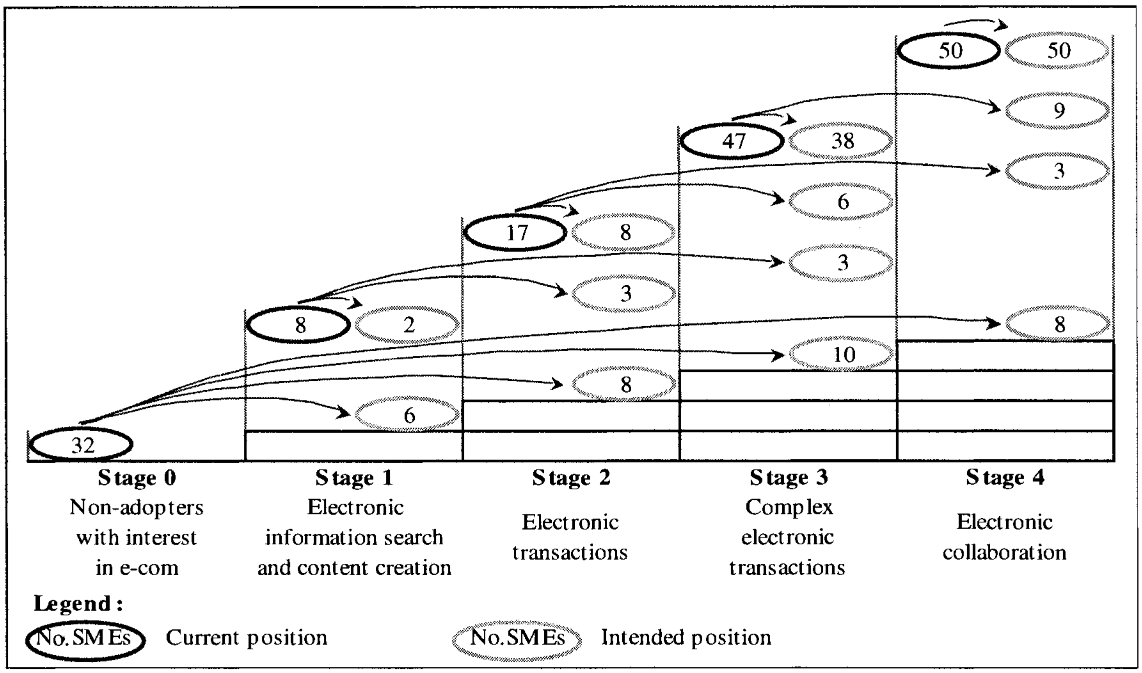


Figure A.3 : E-commerce adoption trajectories

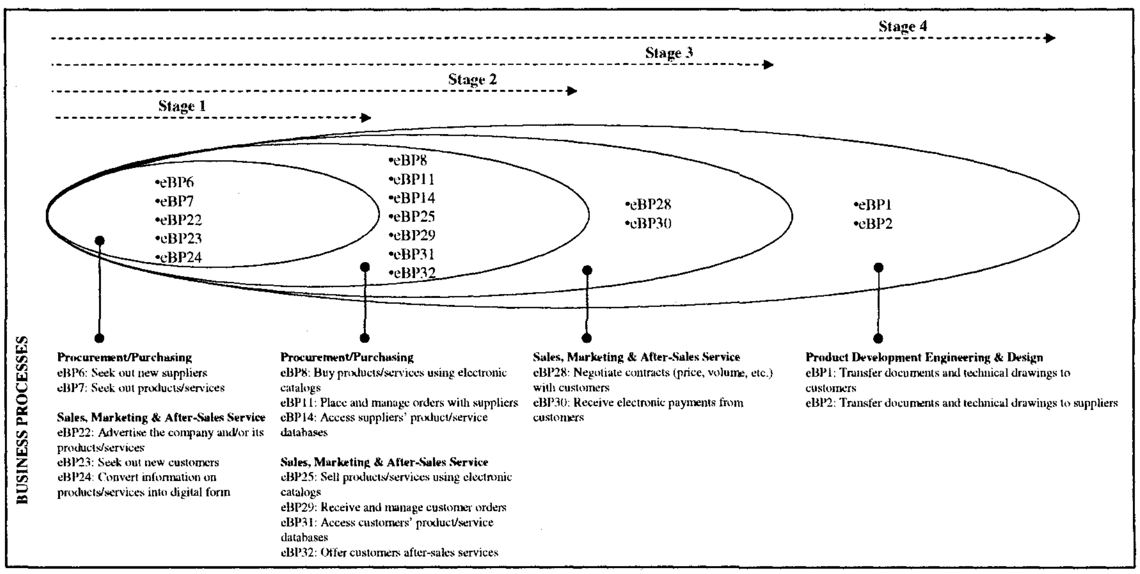
The overall impression gained from figure A.3 is that e-commerce adoption is purposely undertaken in a cumulative, and thus a path-dependent way, and does not seem to be the result of stochastic decisions. The results strongly suggest that SMEs follow e-commerce adoption trajectories; moreover, they clearly indicate a path dependency among SMEs that have adopted e-commerce. While most firms (79%) passed through the stages in order, a few (21%) have jumped stages (see figure A.4). Section A.4.3 will shed some light on the phenomenon of SMEs' jumping stages.

A.4.2.3. The gradual unfolding of B-to-B e-commerce initiatives

Which business processes are now conducted in an electronically mediated environment? For which ones will SMEs rely on electronic means in the near future? Appendix A provides detailed information on the current and intended use of each BP for all e-commerce adopters. Appendix A reveals that all 36 eBPs without exception could be carried out electronically: these eBPS are either currently used or are intended to be used within the next twelve months by the 122 SMEs in our sample. This remark further validates the proposed typology of business processes (figure A.1). Moreover, the frequencies for intended use are greater for each business process than the ones for the actual use: B-to-B e-commerce adoption seems to progress cumulatively and firms migrate towards more sophisticated e-commerce initiatives in all five functional areas. Are firms' intentions aligned with current use? The ranking is rather similar, as shown in the second and fourth columns of Appendix A.A. In fact, there is a significant agreement between the current and future behavior of SMEs with respect to B-to-B e-commerce ($p = .00$, $w = 0.985$ for Kendall's test of concordance in which $p = 0$ indicates complete agreement and $p = 1$ indicates complete disagreement). Hence, the future behavior of SMEs appears to be conditioned by their experience today.

Going one step further, it is possible to obtain the same information as in Appendix A.A but for each of the four stages of the proposed stage model. In order to convey the information more effectively, figure A.4 shows only the most frequently used business processes in each stage. i.e. Those that are actually used by a critical mass of the SMEs in each stage (at least 20%). SMEs in stage 1 mainly use five eBPs, all of which involve information search and content creation activities related to two functional areas, namely marketing, sales and after-sales service (eBP22, eBP23 and eBP24), and procurement/purchasing (eBP26, eBP27). In addition to these five business processes, firms at stage 2 also rely on electronic means for simple e-transactions related to purchasing/procurement (eBP9, eBP11, eB14) and to sales, marketing and after-sales service (eBP25, eBP29, eBP31, eBP32). Firms at stage 3 not only build on the eight business processes displayed in stages 1 and 2 (figure A.4), but undertake more complex e-transactions with their customers by negotiating on-line contract conditions (eBP28) and receiving electronic payments (eBP30). Firms in stage 4 place a strong emphasis on the 14 eBPs listed in stages 1, 2 and 3 as well as on two eBPs related to product development, engineering and design (eBP1, eBP2).

Figure A.4 : The cumulative unfolding of the most frequently adopted eBPs per



stage

Figure A.4 strongly suggests that SMEs adopt more and more e-commerce initiatives, and these eBPs become increasingly complex, as they move through stages 1 to 4. Additional observations can be made. First, e-commerce initiatives seem to be strongly biased towards marketing, sales and after-sales services. This may be explained by the fact that SMEs tend to be "customer-centric". Second, e-commerce initiatives related to product development, engineering and design are adopted by a critical mass of SMEs only in stage 4, whereas those related to distribution and logistics are, for the time being, non existent. This implies that SMEs are still not embracing the full range of B-to-B e-commerce initiatives. Third, intra-firm business processes (eBP3, eBP15, eBP16, eBP17) are also absent in figure A.4, suggesting that internal electronic integration is rather low in an SME context. The lack of electronic integration which is often required to move to more complex eBPs (such as reverse logistics, for instance), may very well restrain SMEs from moving more quickly along their e-commerce adoption trajectories.

A.4.2.4. Benefits of e-commerce

Do SMEs derive benefits from e-commerce adoption?

Participating CEOs were asked to evaluate, on a 7-point scale (with 7 being the highest), ten potential benefits derived from their e-commerce initiatives. Appendix A.B presents the results for this exercise for each adoption stage. Figure A.5 summarizes Appendix A.B and displays only the benefits that received an average score of 3 or higher. A closer look at figure A.5 and at Appendix A.B reveals some interesting results:

(i) The number of concurrent benefits increases with each stage of e-commerce penetration. Although stages 1 and 2 share the same benefits for customer-related activities, firms in stage 3 benefit from reduced delivery time and an increase in market share and revenues. The scope of derived benefits culminates in stage 4 with additional perceived benefits in engineering, manufacturing, and logistics efficiency.

(ii) The fact that no additional benefit is experienced at stage 2 warrants further investigation. One explanation could be the time lag required to achieve additional benefits from the e-commerce initiatives conducted at stage 2.

Capturing benefits from e-procurement and e-sales initiatives in stage 2 (eBP8, eBP11, eBP14, eBP25, eBP29, eBP31, eBP32) may require, on one hand, a longer learning process and, on the other, integration with other business processes that need to be conducted electronically as well. Section A.4.3 will take a closer look at this phenomenon.

(iii) Appendix A.B also shows that the level of intensity increases for most of the benefits as SMEs progress through the stages. This observation reveals a learning process whereby firms evolve and obtain improved benefits from their e-commerce initiatives.

These observations suggest that, as SMEs expand their e-commerce initiatives and assimilate and integrate the corresponding technologies, they experience mounting benefits with respect to both scope (number of benefits) and intensity (score of the benefits).

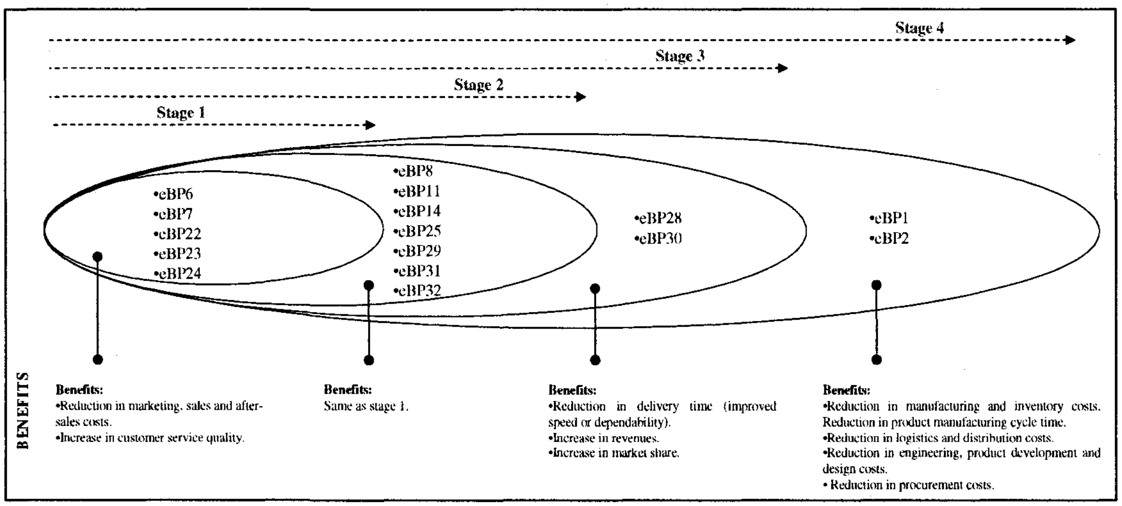


Figure A.5 : The cumulative benefits derived from e-commerce adoption

A.4.3. Findings of the multiple case study

After briefly providing some additional background information on the twelve SMEs involved in the case studies, we will attempt to shed some light on some of the most puzzling results of the e-survey.

A.4.3.1. Additional background information

Two SMEs were randomly selected from each stage of the model presented in figure A.2. In addition to the characteristics of the 192 SMEs displayed in figure A.2, findings from the case studies allow the following comments:

(i) These firms are relatively mature. Most have been in operation for at least 10 years and three of them for more than 25 years. In particular, they have well-established business relationships.

(ii) When firms are active on international markets, these activities are carried out in the U.S., Canada's largest commercial partner, which is very active in e-commerce. Only three SMEs import from other international markets and two export to Europe and Asia.

(iii) A minority of these firms are involved in small, tight networks of five customers or fewer (three firms) or five suppliers or fewer (four firms).

A.4.3.2. The logic behind e-commerce initiatives

Stage 00: A wait-and-see strategy

The CEOs of the two SMEs at stage 00 are reluctant to engage in even the most basic B-to-B e-commerce initiatives. They do not feel any pressure from their business partners, although they know that some larger customers are involved in e-commerce. They do not foresee that any economic payback could be generated at present from e-commerce initiatives. One CEO even stated that e-commerce initiatives are "counterproductive as long as the business partners do not agree on one consolidated set of e-business solutions." Both CEOs and most of the employees have access to the Internet but only for e-mail: they simply view e-mail systems as a faster, cheaper and more convenient way of communicating. In summary, their strategy is essentially a reactive wait-and-see strategy but they are convinced that they will have to eventually engage in e-commerce, "once the way is smoothly paved."

Stage 0: An optimistic outlook

In the next stage (stage 0), the CEOs are planning, with rather comfortable optimism, to be involved in several e-commerce initiatives. They say that they are essentially being "pushed" by their business partners and that they can no longer wait. They seem to consider e-commerce as a competitive necessity, since most of their direct competitors and business partners are already firmly engaged in e-commerce.

Stages 1, 2, 3 and 4: An increasingly cautious and realistic approach in the later stages

Of the eight SMEs that represent the group of adopters (stages 1, 2, 3 and 4), five SMEs have a Web site and, for three of them, the Web site can be described as elaborate. One firm had even implemented a trilingual transactional Web site. Nevertheless, three SMEs without a Web site had no intention of creating one in the near future. Among the reasons for not having a

Web site, the three CEOs stated that it was unnecessary as they could link to their customers' and suppliers' Web sites or to electronic platforms to perform all electronic transactions or other related activities, including e-collaboration activities. The overall approach to e-commerce is increasingly down-to-earth, realistic and cautious as SMEs move from stage 1 to stage 4.

As mentioned by one CEO, "if one moves beyond the e-commerce myth, it is crucial to consider what is really accomplished with e-commerce. Business processes refer to the core activities in our business: they are where the value is created and they are where our e-commerce involvement is directed. We analyze the potential of e-commerce initiatives process by process and only move forward if the benefits outweigh the costs, especially hidden costs."

A.4.3.3. Why do some SMEs leap over stages?

The vast majority of SMEs (79%) in the survey followed the e-commerce adoption trajectories, but a few firms jumped over one or even several stages. Why? Based on the findings of the case studies, three main explanations can be posited:

(i) Inexperience creates high expectations

SMEs with no or limited prior experience with e-commerce (i.e. SMEs in stages 1 and 2) tend to move more quickly. As a CEO puts it bluntly: "We'd move back if we could. Our decision was made hastily based on misconceptions about technology, but, more importantly, about the in-depth implications on our internal activities. Our internal processes were simply not geared towards e-commerce." Another SME experienced an excessive workload, with unsolicited requests and with necessary upgrades and maintenance, despite the fact that three key managers had expected a reduction in staff time further to an aggressive e-commerce strategy.

(ii) E-commerce adoption is largely influenced by powerful stakeholders

In order to comply with the requirements of large customers and prime contractors, some SMEs have to leap over one or two stages but usually with a limited focus on one or two business processes. For instance, one firm had to electronically transfer and modify 3D product designs (BP1, stage 4) although it only had hands-on experience with 2D designs faxed back and forth to its main customers (stage 0). In addition, customers may also require their own specific business solution to be used, whether it is paper-based or electronic. As a result, an SME can face a mixture of traditional procedures (mail, faxes) and various digital procedures. The mix of procedures ranging from stage 0 to stage 3, or even stage 4, is counterproductive, has hidden costs and can be frustrating for SMEs.

(iii) Electronic platforms offer some advanced e-commerce functionalities in a rather user-friendly fashion.

Two SMEs are offering products and services on sectorial electronic platforms. The first SME gained increased visibility, was successful in bidding in reverse electronic auctions (eBP26, stage 3), obtained several large contracts and expanded its market share abroad. From its experience, the CEO concluded: "Although our previous experience with B-to-B e-commerce was limited, electronic bidding is not difficult per se, at least in this particular platform, but the reengineering of our internal processes in order to respond to the electronic bidding is much harder." The second SME, which also had very limited experience in e-commerce (stage 2), gained access to sophisticated e-collaboration tools and within six months was performing on-line collaborative engineering with its main customer (stage 4). The user-friendliness and the low annual membership fees of this sectorial electronic platform largely explained the leap over one stage.

A.4.3.4. Why do benefits seem to stall at stage 2?

According to the two SMEs at stage 2, there is a “backlash” effect at stage 2. Hidden costs for maintenance and upgrades and the excessive workload generated by stage 1 initiatives such as a Web presence (eBP22) seem to offset the additional benefits that could be gained at stage 2. Stage 2 basically reinforces the benefits of stage 1 and hidden costs “pop up” at stage 2 due to a time lag effect. When CEOs from more experienced SMEs (stages 3 and 4) reflect back on their own experience in stage 2, they state that e-commerce tends to pervade all business activities and generate wider impacts than anyone had expected.

A.5. Conclusion

The study findings should be interpreted in the light of certain limitations, as the research design clearly corresponds to exploratory research. In particular, the sample size (n = 192) is rather small and may preclude one from making comprehensive generalizations. However, considerable efforts were made to obtain multiple sources of empirical evidence. Triangulation increases internal validity.

The empirical results of all three phases of the research design validate the proposed typology of the 36 eBPs to measure B-to-B e-commerce adoption in the specific context of manufacturing SMEs. The proposed typology indicates that e-commerce is indeed a highly pervasive innovation since the 36 business processes cover all major functional areas as well as intra- and inter-firm electronic integration initiatives. The proposed stage model of e-commerce adoption receives also some extensive validation: the vast majority of SMEs (79%) follow cumulative linear adoption patterns moving progressively from stage 0 to stage 4. However, some SMEs (21%) did not follow linear patterns as they jumped over one and even several stages. Evidence from the multiple case studies show that these firms were either inexperienced or influenced by external forces and would probably have preferred to gain experience gradually before moving to the next stage. Future behavior seems largely conditioned by their current experience. One other important finding is that SMEs are reaping benefits derived from e-commerce in a cumulative fashion which is coherent and aligned with their e-commerce initiatives. Both the scope and intensity of these benefits increase in the later stages of e-commerce adoption as organizational learning gradually takes place. Finally, and this may be the most important result, there is no indication that any of the SMEs were likely to regress to a previous stage. The process of B-to-B e-commerce penetration seems irreversible, as the CEOs of those SMEs clearly indicate that they intend to engage in even more e-commerce activities.

Several contributions emerge from the study. First, we have attempted to derive improved metrics of e-commerce adoption based on an integrative and process-based approach, and metrics are essential if research is to progress. Both the stage model for e-commerce adoption and the scores of e-commerce penetration may represent valuable first efforts to capture one dimension of the digital economy. Second, our findings suggest logical evolutionary paths to the gradual unfolding of B-to-B e-commerce in SMEs. The cumulative and self-reinforcing nature of both e-commerce initiatives (i.e. eBP) and the benefits derived there from points to the existence of e-commerce adoption trajectories.

A.A. Appendix A.A : Actual and future use of eBPs (n = 122)

Process #	EBPs by broad generic functional activities	Actual use		Intended use	
		Frequency	Rank	Frequency	Rank
	Product Development, Engineering & Design:				
eBP1	Transfer documents and technical drawings to customers.	31%	12	40%	13
eBP2	Transfer documents and technical drawings to suppliers.	32%	11	40%	13
eBP3	Integrate software supporting product design.	18%	18	35%	16
eBP4	Do collaborative on-line engineering with suppliers.	16%	21	21%	23
eBP5	Do collaborative on-line engineering with customers.	21%	16	27%	19
	Procurement/Purchasing:				
eBP6	Seek out new suppliers.	43%	5	64%	5
eBP7	Seek out products/services.	45%	4	67%	2
eBP8	Buy products/services using electronic catalogs.	34%	7	54%	6
eBP9	Buy products/services by electronic auction.	6%	26	13%	26
eBP10	Buy products/services by issuing electronic calls for tenders.	2%	19	28%	18
eBP11	Place and manage orders with suppliers.	34%	7	48%	9
eBP12	Negotiate contracts (price, volume, etc.) with suppliers.	16%	20	27%	19
eBP13	Make electronic payments to suppliers.	11%	24	21%	21
eBP14	Access suppliers' product/service databases.	31%	12	53%	7
	Production/Operations:				
eBP15	Automate the production floor using a manufacturing execution system (MES).	None	31	3%	36
eBP16	Integrate the MES into the management information system.	None	31	7%	30
eBP17	Ensure the management of quality assurance using the management information system.	4%	28	8%	29
eBP18	Allow customers to access the company's inventories.	3%	30	6%	32
eBP19	Access customers' inventories.	5%	27	5%	34
eBP20	Allow suppliers to access the company's inventories.	None	31	4%	35
eBP21	Access suppliers' inventories.	8%	25	17%	24
	Sales, Marketing & After-Sales Service:				
eBP22	Advertise the company and/or its products/services.	60%	1	75%	1
eBP23	Seek out new customers.	52%	2	66%	4
eBP24	Convert information on products/services into digital form.	33%	9	44%	10
eBP25	Sell products/services using electronic catalogs.	24%	15	43%	11
eBP26	Sell products/services by electronic auction.	None	31	6%	32
eBP27	Sell products/services by responding to electronic calls for tenders.	12%	22	15%	25
eBP28	Negotiate contracts (price, volume, etc.) with customers.	26%	14	36%	15
eBP29	Receive and manage customer orders.	51%	3	66%	3
eBP30	Receive electronic payments from customers.	21%	16	34%	17
eBP31	Access customers' product/service databases.	33%	9	43%	11
eBP32	Offer customers after-sales services.	37%	6	50%	8
	Distribution & Logistics:				
eBP33	Automate distribution/logistics using a logistics execution system.	4%	28	10%	27
eBP34	Allow distribution/transportation partners to access the information they need.	None	31	10%	27
eBP35	Optimize returns management ("reverse logistics").	None	31	7%	30
eBP36	Track products (purchased and sold) during transportation.	12%	22	21%	21

A.B. Appendix A.B : Derived benefits per stage

	Stage 1 ($n_1 = 8$)	Stage 2 ($n_2 = 17$)	Stage 3 ($n_3 = 47$)	Stage 4 ($n_4 = 50$)	p (1)
Benefits derived from e-commerce adoption					
Increase in customer service quality	**3.67**	**4.17**	**3.91**	**4.68**	NS
Reduction in marketing, sales & after-sales costs	**3.67**	**3.00**	**3.26**	**3.90**	NS
Reduction in delivery time (improved speed/dependability)	2.33	2.58	**3.35**	**4.10**	*
Increase in market share	2.83	2.92	**3.51**	**3.78**	*
Increase in revenues	2.33	2.58	**3.37**	**3.78**	*
Reduction in procurement costs	2.83	2.67	2.91	**3.63**	NS
Reduction in eng., product develop. & design costs	2.00	2.25	2.24	**3.97**	***
Reduction in manufacturing & inventory costs	2.00	2.00	2.15	**3.31**	**
Reduction in product manufacturing cycle time	2.17	2.42	2.38	**3.26**	NS
Reduction in logistics & distribution costs	2.50	2.50	2.68	**3.45**	NS

(1) p = level of significance of the Kruskal-Wallis Test (non-parametric ANOVA) * = $p < .10$; ** = $p < .05$; *** = $p < .01$; **** = $p < .001$.

ANNEXE B. IMPACTS OF RFID ON WAREHOUSE MANAGEMENT IN THE RETAIL INDUSTRY

Abstract

Based on a field study conducted in the retail industry, this paper examines the impacts and the potential benefits generated by an RFID application in a warehousing environment. Through a detailed investigation of the underlying business processes, we will demonstrate how process optimization can be achieved when integrating RFID technology.

B.1. Introduction

Even though RFID (Radio Frequency Identification) technology has been around for decades, it has only recently gained a strong academic and industry interest (Sheffi, 2004; Collins, 2003). Industrial applications of RFID are spreading as very large organizations such as Hewlett-Packard, Wal-Mart and the American Department of Defense are now pressuring their most important suppliers to adopt this technology (Sliwa, 2004; Dignan, 2004; Barlas, 2003). Although RFID represents a simple technology, its numerous applications can become quite complex. A basic RFID system is composed of three layers: a chip/tag, a reader and a computer. The tag is attached to or embedded in a physical object and communicates wirelessly (e.g. without line of sight) with the reader. A network of readers can therefore follow the object throughout the physical world. The readers send the location and the identification of the object to a computer which adjusts or initiates business processes automatically (Kärkkäinen et al. 2003).
This paper focuses on the impact of RFID technology on warehousing activities in the retail industry. These activities represent one of the critical elements of the supply chain: opportunities to optimize warehouse business processes are

numerous (Mills, 2000; Moore, 2004) and can have an impact on the whole supply chain performance.

B.2. Background

B.2.1. Current Context of the Retail Industry

The retail industry represents one of the largest industries worldwide. In the United States, it is the second-largest industry (in terms of the number of establishments and the number of employees), with $3.8 trillion in sales annually and 11.7 percent of U.S. employment (Vargas, 2004). This industry is characterized by globalization, aggressive competition, shorter product life cycles, increasing cost pressures and the rise of customized demand with high product variants. The short shelf-life of grocery goods presents some of the biggest challenges for the retail supply chain management due to the strict traceability requirements and the need for temperature control in the supply chain (Kärkkäinen, 2003). The short shelf life of grocery goods makes warehousing management a time-critical operation (Mangina and Vlachos, 2005).

Despite the high number of products handled in the supply-chain, a large number of American businesses are still using manual and thus error-prone methods to collect data (Quinn, 2004), causing inventory inaccuracies (Fleisch and Tellkamp, 2005; Raman et al. 2001). However, in order to stay competitive, companies must optimize their internal (intra-organizational) and external (inter-organizational) processes. This later phenomenon is particularly evident in the consumer product good (CPG) branch, where multiple players are involved in the delivery of the products, contributing to the complexity of the supply chain. In addition, data inaccuracies in the supply chain are costly. Incorrect or outdated data used in invoices, bills of lading (a document from the carrier indicating the description of the goods being shipped) or purchase orders can result in product delivery errors and lost sales estimated to more than $50 billion annually (UCCnet, 2004).

With the intent of streamlining their supply chain processes and of controlling costs, leading CPG distributors around the world are relying more heavily on the use of information technologies. Applications such as enterprise resource planning (ERP), materials requirement planning (MRP), manufacturing resources planning (MRPII), warehouse management system (WMS), advanced planning and scheduling (APS), Electronic Data Interchange (EDI), automatic identification and data collection (AIDC), etc. are currently used to support the intra- and inter- organizational business processes, decision-making, workflow management and automatic information exchange with their supply chain partners. In addition, new customer-focused concepts are progressively introduced into the management of retail supply chains in order to improve performance (Sparks and Wagner, 2003). These concepts cover for example quick response (QR), efficient consumer response (ECR), vendor-managed inventory (VMI), point of sale (POS) and collaborative planning, forecasting and replenishment (CPFR) (Seifert, 2003; Sparks and Wagner, 2003).

B.2.2. RFID Early Adopters in the Retail Industry

RFID technology does indeed have the potential to be quite beneficial for the retail industry. Wal-Mart, for example, has been analysing its potential for more than a decade (Roberti, 2003). In fact, Wal-Mart has now become a major reference in the adoption of RFID in the retail industry since it officially disclosed its RFID initiative in 2003 (Sullivan, 2004). Coined as the "Wal-Mart effect", the company detains sufficient power to influence its suppliers (Goldman and Cleeland, 2003) and thus determines to a large extent the technology adoption paths of these suppliers: it had set January 2005 as the deadline for its 100 top suppliers to incorporate RFID technology for all their deliveries at the pallet level (Wired News, 2003). While a few have even successfully incorporated RFID at the product level (Wal-Mart, 2005), the latest information suggests that not all suppliers have completely met the 2005 deadline (Kevan, 2004). Yet the vast majority are trying to comply although it may be with little enthusiasm (O'Connor, 2005). Wal-Mart stands to save substantial amounts from supply chain optimization, just-in-time deliveries and disappearance of stock-outs. The retail giant will know exactly where a product is throughout its entire supply chain and could theoretically track a product from its suppliers' supplier location.

Wal-Mart states that the business goal derived from this RFID initiative is to "increase customer satisfaction in the near-term and ultimately play an important role in helping us control costs and continue offering low prices" (Wal-Mart, 2004). Additionally, benefits could be realized such as informing customers that the products they are looking for are in stock, monitoring product expiration dates or acting quickly during recalls, improving supply chain processes so that the right products are in the right places at the right time, and, cutting inventories by 5% and labor costs in the warehouse by 7.5% (Pruitt, 2004; A.T. Kearney, 2003).

Other companies in the retail space are also interested by the potential benefits that the RFID technology offers. In 2003, Metro Group in Germany had already gone beyond the pilot phase as it had opened its first "Extra Future Store" where RFID is used in a live supermarket environment (Collins, 2004). This phenomenon has created much excitement in the retail industry among technology suppliers and people wanting to optimize their processes. In fact, so much excitement has been created in a relatively short timeframe that tag suppliers have not been able to completely respond to the demand, resulting in a shortage of RFID tags in 2004 (Trebilcock, 2004).

B.2.3. Warehousing and the Potential of RFID

Basically, there are three types of warehouses (Berg and Zijm, 1999): (i) a distribution warehouse where products from different suppliers are collected and sometimes assembled for delivery to a number of customers, (ii) a contract warehouse which performs the same activities as a distribution warehouse for one or many customers, (iii) a production warehouse which is located in a production facility and is dedicated to the storage of raw materials, semi-finished and finished products. Warehouse management can be analyzed from three perspectives (Rouwenhorst et al. 2000) namely the process perspective (steps undertaken in a warehouse), the resource perspective (equipment and personnel needed) and the organization perspective (planning and control procedures).

In this study, we have investigated one distribution warehouse and have chosen the process perspective. This deliberate choice arises from our intention to understand HOW the work is carried out within one type of a distribution warehouse in order to fully grasp the impacts of implementing RFID. Four distinct warehousing activities are usually identified (Rouwenhorst et al. 2000; Berg and Zijm, 1999) and can benefit from RFID technology:

1. The receiving process is handled when products or items arrive at the warehouse. At this step, received items or products are checked with documents such as purchase order (PO) or an advanced shipping notice (ASN). When there is a match, the receiver can apply a label to the pallet/item for tracking throughout the warehouse. When there is no match, the receiver has to confirm the discrepancy which often involves another person (a manager for example). Receiving is time consuming and subject to human error (Keith et al. 2002), making it a good candidate for RFID technology.
2. The put-away process consists of moving and placing products or items to specific storage locations. This process can be greatly improved by automation. For example, the use of a mobile terminal allows to scan

different bar codes on pallets or products and automatically display their storage locations. Cost savings related to the put-away process in a warehouse derived from the adoption of RFID technology could reach 50% (Capone et al. 2004), thus positioning this process as another candidate for RFID technology.

3. The picking process refers to the retrieval of products or items from their storage locations for the consolidation of customer orders. This process is labor intensive and prone to human error. For example, case picking can occupy up to half the staff in a distribution center and requires many verifications (Keith et al. 2002). Globally, order picking represents 50–75% of the total operating costs in a warehouse (Petersen and Aase, 2004).
4. The shipping process is performed before the products reach the end customers. Customer orders are checked, packed and loaded in trailers, trucks, trains or any other transportation unit and have to match with outbound orders all the time. Again, the verification attached to this process highly depends on the level of automation.

B.3. Methodology

Our methodology builds on previous work (Strassner and Schoch, 2004; Subirana et al. 2003) and focuses on one specific "open-loop" supply chain RFID initiative in the retail industry.

As the main objective of this study is to examine the impacts and the potential benefits generated by an RFID application in a warehousing environment, the research design corresponds to an exploratory research initiative. Field research was conducted in 12 consecutive steps (see Table B.1, adapted from (Lefebvre et al. 2006).

Table B.1 : Steps undertaken in the field study with emphasis on scenario

	Detailed activities
	Phase 1: Opportunity Seeking
Step 1	**Determination of the primary motivation** to consider the use of RFID technologies **(WHY?)**
Step 2	**Analysis of the Product Value Chain (PVC)** specific to a given product **(WHAT?)**
Step 3	**Identification of the critical activities in the PVC:** Identification of critical PVC activities (**WHICH** activities to select and **WHY?)**
Step 4	**Mapping of the network of firms supporting the PVC;** to understand the links within the network of firms supporting the product **(WHO and WITH WHOM?)**
Step 5-6	**Mapping of intra- and inter organizational processes** for the identified opportunities as they are carried out now ("As is") **(HOW within and between organization?)**
	Phase 2: Scenario Building and Validation
Step 7	**Evaluation of RFID opportunities** in the PVC with respect to the product (level of granularity), to the firms involved in the SC and to the specific activities in the PVC
Step 8	**Evaluation of potential RFID applications including scenario building** and process optimization ("As could be") **(HOW within and between organizations?)**
Step 9	**Mapping of intra- and inter-organizational processes integrating RFID technology**
Step 10	**Validating business and technological processes integrating RFID technology with key respondents** Feasibility analysis including ERP and middleware integration and business process redesign
	Phase 3: Scenario Demonstration and Analysis
Step 11	**Proof of concept (POC) in laboratory simulating RFID physical environment and interface between supply chain players:** feasibility demonstration and evaluation including ERP and middleware integration and process redesign at all the supply chain members' level **Proof of concept post-analysis and decision to go for the** pilot replicating POC scenarios in a real-life setting
Step 12	**Pilot** project and evaluation of anticipated vs. realized benefits and impacts of RFID. **Appropriation by the different organizations involved**

demonstration and analysis

B.4. Results

Within the scope of this paper, we will present and discuss only one of the scenarios proposed for the "receiving" and "put-away" processes.

Figure B.1 summarizes the results obtained from the field research. Processes displayed in figure B.1 are drilled down, i.e. from the more general to the more detailed: for instance, the overall process corresponds to "receiving process", first level process to “1. receive bill of lading (BOL)”, and second level process to “1.1. create a BOL in the ERP”, and so on.

On the left hand side of figure B.1, the actual or existing processes are presented. The following observations can be made:

(i) the two overall “receiving” and “put-away” processes consist respectively of 17 and 5 second level processes, for a total of 22;

(ii) most existing processes involve numerous interventions from the employees such as pallet scans, visual count of boxes in each pallet or data input;

(iii) the “put-away” process starts with the end of the “receiving” process. Received products are in a staging area while a message has been manually sent from the warehouse management system to a dedicated forklift terminal via radio frequency in order to initiate the put-away.

On the right hand side of figure B.1, the potential impacts of RFID on the same two overall processes are investigated. This corresponds to the following scenario: all products (boxes and pallets) have an RFID tag, the warehouse is equipped with RFID readers and the existing ERP has a middleware to integrate data read from RFID tags. Interesting observations emerge from this scenario:

(iv) the number of processes drops from 22 second level processes in the existing context to 8 second level and 5 third level processes with RFID technology;

(v) the two overall processes are merged together;

(vi) all information-based processes (1.1.1., 1.1.2., 1.1.3., 2.5.1., and 2.5.2.) are now automatically performed. In fact, the use of RFID automates verification procedures during the receiving process and provides accurate information at a very high level of granularity (pallet, box) allowing the possibility to generate efficiency measures in real-time and making transparent the flow of products. RFID can also eliminate most paper-based documents generated from traditional receiving and put-away processes. Finally, operational improvements such as removing manual checks and eliminating human errors can also derive from the RFID technology.

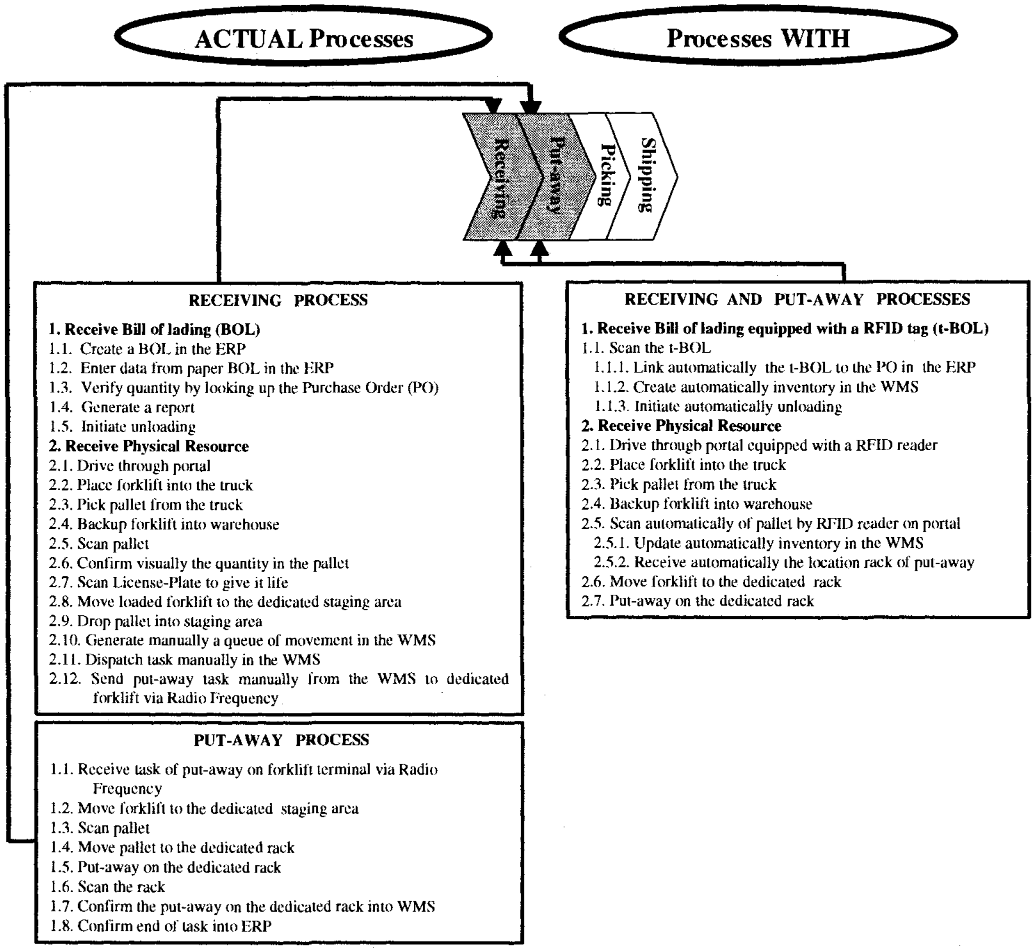


Figure B.1 : The impact of RFID on two warehouse processes

B.5. Conclusion and future research avenues

The results from the three-step field research demonstrate the potential of RFID technology in warehousing activities. The next steps will be to test the technology in a Beta site and then in a real-life environment.

This paper makes several contributions. First, in order to capture the real potential of RFID, the business process approach seems quite appropriate. Second, RFID can improve the “receiving” and “put-away” processes in the warehouse. By extension, RFID technology could optimize the entire warehouse processes as well as the entire supply-chain processes. In fact, RFID can be seen as a support for information sharing among the players in the supply-chain. In our scenario, the same RFID tag used for the shipping by the suppliers could be used during the receiving in the warehouse. The same tag could also be used during the shipping process to the final customer and ultimately respond to different interests of the business partners in one supply-chain. Third, the preliminary results from our study show that RFID technology triggers automatically some business processes. As products attached with RFID tags become “intelligent or smart”, a world of possibilities unfastens. Despite considerable technological and organizational challenges, the future of RFID seems promising.